NOTICE

All drawings located at the end of the document.

RF/RMRS-99-433.UN

1998 ANNUAL ROCKY FLATS CLEANUP AGREEMENT

(RFCA)

GROUNDWATER MONITORING REPORT

for the

Rocky Flats Environmental Technology Site

November 30, 1999

RMRS Rocky Mountain Remediation Servic
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EXECUTIVE SUMMARY

This report, which is required annually by the Rocky Flats Cleanup Agreement (RFCA, 1996), summarizes the groundwater compliance activities and results at the Rocky Flats Environmental Technology Site (RFETS) for calendar year (CY) 1998. The report is presented in one volume which contains text, tables, figures, plates and appendices.

Section 1 serves as a brief introduction to the report and summarizes the Site environmental history and hydrogeologic setting. Section 2, Data Analysis, discusses the groundwater quality data collected in CY98 and contains a data quality assessment regarding the precision, accuracy, representativeness, completeness, and comparability (PARCC parameters) of analytical data. In addition, Section 2 contains updated composite plume maps for volatile organic compounds (VOCs) and nitrate. Section 3 presents groundwater flow conditions during CY98, and compares them to groundwater flow conditions documented during CY96. Hydrologic conditions during calendar year 1996 are considered to represent a sitewide baseline to be used in assessing annual changes to the groundwater flow system in the remaining years of plant closure and post-closure monitoring. Section 4, Groundwater Evaluations, discusses the evaluation activities that are in progress for areas of the Site having reportable concentration values or where it is known that contaminant plumes have reached surface water. Section 5 presents a summary of decontamination and decommissioning (D&D) activities, with respect to groundwater, that have taken place during 1998. Section 6 presents a summary of other CY98 groundwater characterization activities at RFETS that involved groundwater issues. Section 7 serves to outline other Groundwater Program activities including the Well Control Program (WCP), the real time groundwater monitoring network, 1998 well abandonment and installation activities, and a summary of activities at the Present Landfill. Section 8 presents conclusions and recommendations for future groundwater characterization activities. Section 9 lists all references that are cited in the text of this document.

There are four appendices to this report. Appendix A consists of CY98 water level data. Appendix B presents well hydrographs. Appendix C.1 presents 1998 borehole logs. Appendix C.2 presents 1998 well construction logs

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1.0 INTRODUCTION

This Annual Groundwater Monitoring Report summarizes the groundwater monitoring activities and results at Rocky Flats Environmental Technology Site RFETS for calendar year 1998 (CY98), as required in the Rocky Flats Cleanup Agreement (RFCA), and outlined in the Integrated Monitoring Plan (IMP) (K-H, 1998a). Section 1 serves as a brief introduction to the report. Section 2 discusses the groundwater quality data collected in CY98. Section 3 presents baseline hydrogeologic data for the recently defined RFCA groundwater monitoring network. Section 4 discusses the groundwater evaluation activities that are in process. Section 5 discusses Building Decontamination and Decommissioning (D&D) with respect to groundwater issues. Sections 6 and 7 give a brief summary of pre-remedial characterization and other activities at RFETS in CY98 that involve groundwater.

1.1 Site Description

Rocky Flats Environmental Technology Site is located 16 miles northwest of Denver in Jefferson County, Colorado. The Site is a U.S. government-owned and contractor-operated facility that encompasses approximately 6,550 acres of federally-owned land (Figure 1-1). Site ownership, however, does not include surface and subsurface minerals or water rights. Site construction was initiated in 1951 and operations were begun in 1952.

Prior to the current closure mission, RFETS was part of the nationwide nuclear weapons research, development, and production complex. The plant produced metal components for nuclear weapons from plutonium, uranium, beryllium, and stainless steel. Other production activities included chemical recovery and purification of recyclable transuranic radionuclides, metal fabrication and assembly, and related quality control functions. The plant conducted research and development programs in metallurgy, machining, nondestructive testing, coatings, remote engineering, chemistry, and physics. Parts manufactured at the Site were shipped offsite for final assembly.

Major plant structures, including all production buildings, are located within a centralized 400-acre Industrial Area (IA) of the Site that is surrounded by a 6,150-acre Buffer Zone. Industrial activity immediately adjoining the Site includes present and/or prior coal and clay mining, petroleum recovery, natural classified-aggregate quarrying, and fabricated-aggregate mining. Other activities include cattle ranching and wind energy research. Several irrigation ditches traverse the Site, transmitting water for

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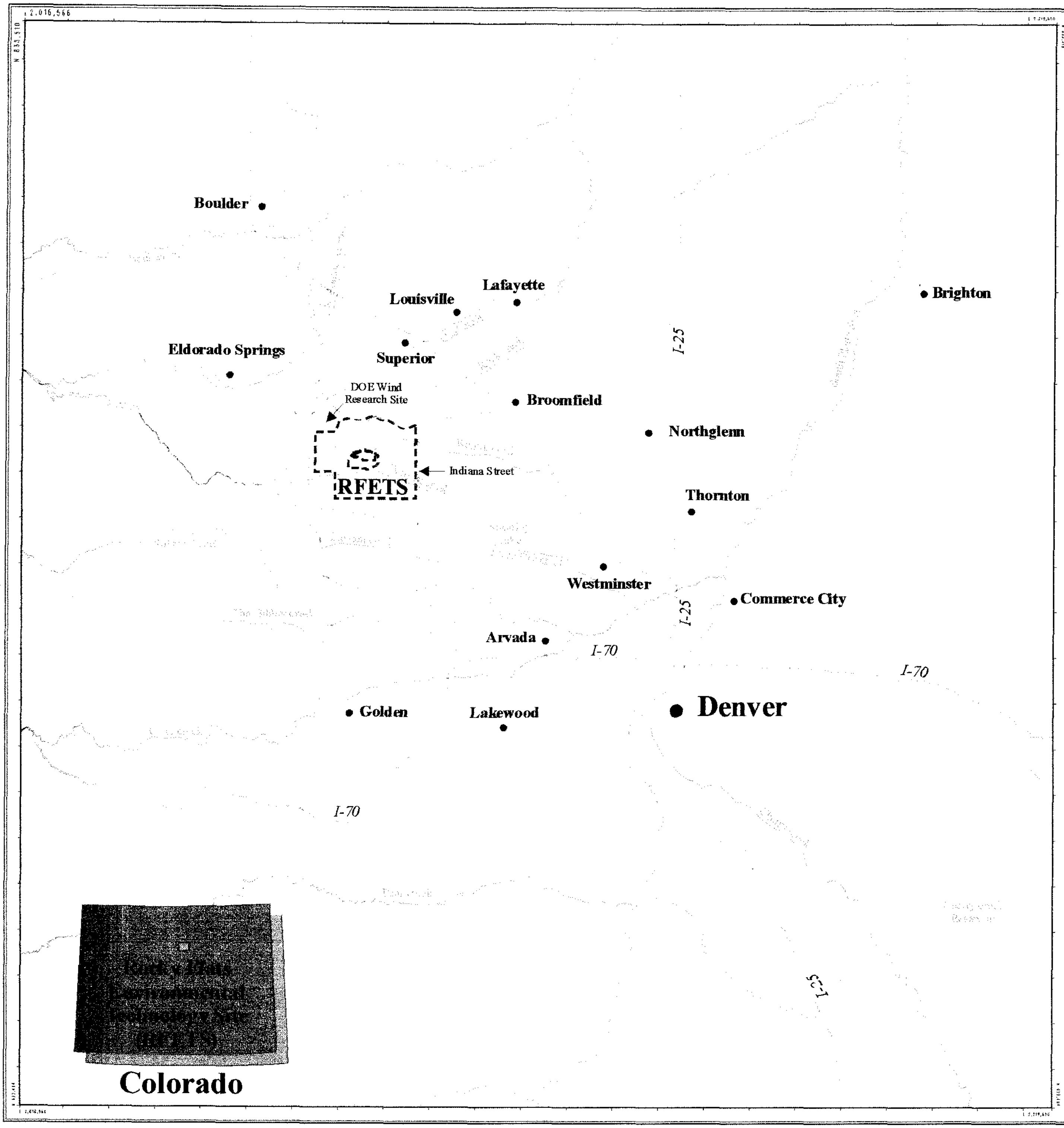

Figure 1-1 Location of Rocky Flats Environmental Technology Site (RFETS)

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5,000' 0' 10,000' 20,000'
Scale in Feet

downstream agricultural, industrial, and municipal purposes. Three ephemeral streams drain the Site and flow eastward (see Figure 1-2).

1.2 Geology and Hydrogeology

1.2.1 Introduction

The Site is situated approximately two miles east of the Front Range of Colorado (Figure 1-1), on the western margin of the Colorado Piedmont section of the Great Plains Physiographic Province (Spencer, 1961). Haun and Kent (1965) have summarized the geologic history of the Colorado Rocky Mountain region, which includes the Site area. The elevation at the Site is approximately 6,000 feet above mean sea level (MSL). The Industrial Area of the Site is located on an alluvial-covered pediment. The upper surface of the alluvium slopes easterly 1 to 2 degrees. Most of the surrounding area in the Buffer Zone is more prominently dissected with intermittent streams. These small, eastward flowing streams include Rock Creek, Walnut Creek, Woman Creek, and several surface water diversion ditches.

1.2.2 Stratigraphy

The stratigraphic sequence that underlies the Site extends from the crystalline Precambrian gneiss, schist, and granitoids at 3,000 feet below MSL to the unconsolidated Quaternary deposits at the surface approximately 6,000 feet above MSL. Based upon aerial photographic interpretation, field geologic mapping, coal and aggregate mine development, petroleum exploration in the vicinity, and numerous borehole investigations, a substantial amount of lithologic information has been gained about the Site. The generalized lithologic section in the Rocky Flats area is shown in Figure 1-3.

Bedrock formations from the uppermost Cretaceous Pierre, Fox Hills, Laramie, and Arapahoe Formations are present and exposed at the surface or lie beneath the Site. The Quaternary Rocky Flats Alluvium, and to a limited extent Verdos Alluvium, unconformably overlie the Cretaceous Arapahoe and Laramie Formations in the central portion of the Site. The unconsolidated surficial deposits, combined with the weathered portion of subcropping bedrock formations, form the sequence of rocks that have the greatest importance regarding groundwater flow and contaminant transport at the Site.

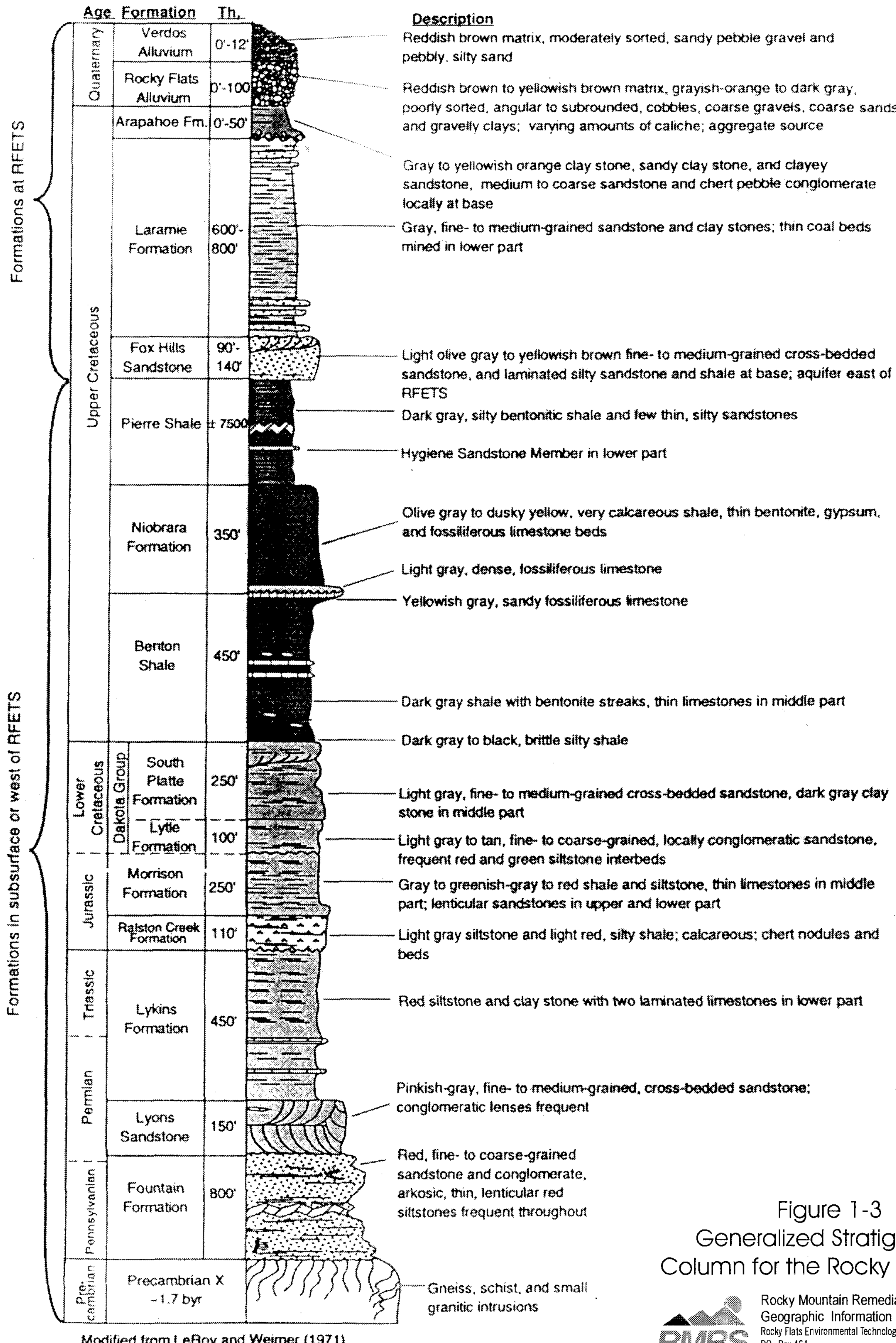

Figure 1-3
Generalized Stratigraphic Column for the Rocky Flats Area

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1.2.2.1 Rocky Flats Alluvium

Scott (1975) has identified several Quaternary alluvial formation pediment covers in the vicinity of the Site. The Rocky Flats Alluvium is an unconsolidated deposit derived from quartzites and granites of the Coal Creek Canyon provenance west of the Site. The deposit diminishes from west to east with thicknesses ranging from approximately 100 feet to less than one foot. In the central portion of the Sitethe deposit is approximately 15 to 25 feet thick. The Rocky Flats Alluvium is a heterogeneous deposit dominantly composed of angular to subrounded, poorly-sorted, coarse, bouldery-gravel with a clay and sand matrix. Clay, silt, and sand lenses as well as varying amounts of caliche are also present.

Exposures of Rocky Flats Alluvium in the aggregate quarries north and west of the Site exhibit some large scale cross-stratification. Depositional processes include fluvial and debris-flow transport (Shroba and Carrara, 1994) infilling paleotopographic lows and leaving a widespread surface of erosion with extremely low relief.

1.2.2.2 Other Surficial Deposits

In addition to the pediment-forming alluvial deposits, younger Quaternary units consisting of colluvium, landslide alluvium, and valley fill alluvium mantle the hillslopes and valley bottoms below the pediment surface. Colluvial deposits are derived from Arapahoe and Laramie Formations and older alluvial deposits. This unit consists of sheetwash, soil creep, and landslide materials with a total thickness of 3 to 16 feet (Shroba and Carrara, 1994). These deposits locally flank the Rocky Flats Alluvium and generally extend to lower parts of the slopes along the principal drainages.

Landslide deposits more commonly flank the Rocky Flats Alluvium. They are often bounded by headwall scarps and lobate toes at the downslope margins. Seeps issuing from the base of the Rocky Flats Alluvium contribute to landslide colluvium generation. The landslide units include earth flows, slumps, and debris flows with thicknesses estimated between 10 to 33 feet (Shroba and Carrara, 1994).

Valley-fill alluvial deposits, present in the bottoms of modern stream channels, flood plains, and terraces, are composed of clay, silt, sand, and gravel. They are commonly less than 10 feet thick but can be tens of feet thick. Usually these deposits contain more sand and are more well-sorted than the Rocky Flats Alluvium.

1.2.2.3 Arapahoe Formation

The Arapahoe Formation is composed of claystone and silty claystone with lenticular sandstone in the basal portion of the formation. The Arapahoe Formation is generally less than 25 feet thick in the Site area, occurring as erosional remnants of fine grained sandstone above the Laramie Formation at various locations on Site (EG&G, 1995a). This basal Arapahoe Formation sandstone, which is currently defined as the No. 1 Sandstone, is of concern as a potential contamination pathway, especially where it subcrops beneath the alluvial/bedrock unconformity.

1.2.2.4 Laramie and Fox Hills Sandstone Formations

The Laramie Formation is approximately 600 to 800 feet thick and is composed of a lower sandstone/claystone/coal interval and an upper, thick claystone interval. Within the upper claystone interval, thin, lenticular sandstone lenses (i.e., Sandstones 2 through 5 in the 1991 Geologic Characterization Report (EG&G, 1991a)) occur. The discontinuous nature of these sandstone lenses coupled with the large claystone layer that encloses them mitigates their potential for transmitting groundwater contamination in both a horizontal and vertical direction.

The Fox Hills sandstone is primarily fine-grained sandstone with thin siltstone and claystone interbeds and an approximate thickness of between 75 and 125 feet. The Fox Hills sandstone crops out and subcrops along a narrow, north-south trending pattern in the extreme western part of the Site, upgradient from known sources of contamination.

The permeable lower sandstones and coals of the Laramie, combined with the permeable sandstones of the Fox Hills, constitute a regional aquifer system known as the Laramie-Fox Hills aquifer. This aquifer system is an important water source in the South Platte River Basin (Pearl, 1980), and is the sole water supply for some residents in the Rocky Flats area. This aquifer lies approximately 500 to 600 feet below the Industrial Area and is protected from possible contamination by the intervening Laramie Formation claystones.

1.2.2.5 Pierre Formation

The Pierre Formation is a 7,500-foot thick, dark gray, silty bentonitic shale that acts as a lower confining layer for the Laramie-Fox Hills aquifer in the Denver Basin. This thick marine shale unit subcrops only in the extreme western part of the Site.

1.2.3 Geologic Structure

The Site is located along the western margin of the Denver Basin, an asymmetric basin with a steeply east-dipping western flank and a gentle eastern flank. The interpretation of the subsurface structure is generalized in the east-west geological cross section of the Site area presented in Figure 1-4. A monoclinal fold limb exposed west of the Site is the most significant surficial structural feature in the Site area. Along the west limb of the fold, an angular unconformity exists between the Upper Cretaceous bedrock and the base of the Quaternary Rocky Flats Alluvium.

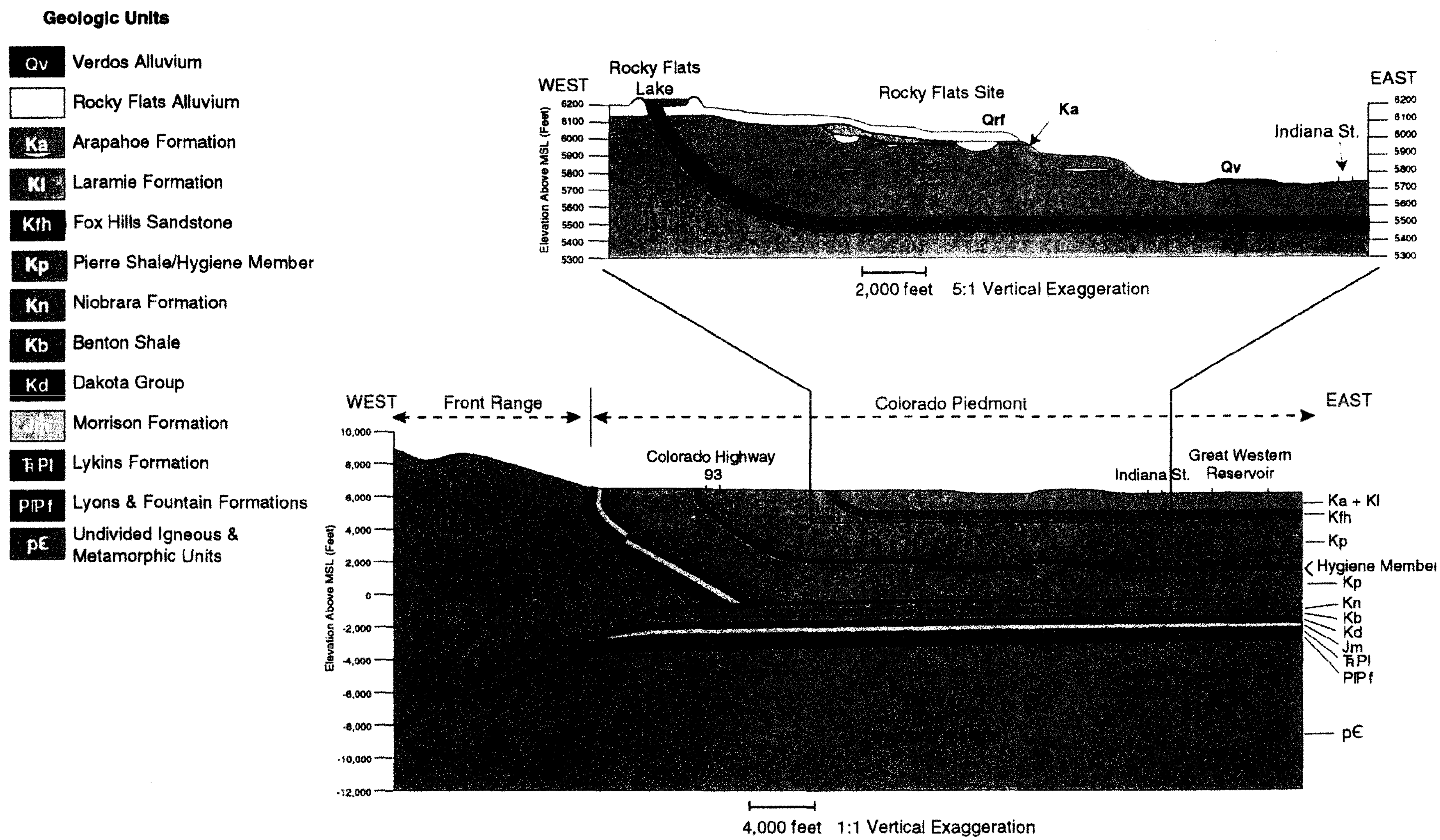
No active faults have been identified at the Site. Several high angle bedrock faults have been inferred to exist in the IA based on various stratigraphic and borehole correlation criteria. These faults appear to have only a limited hydrologic significance with regard to vertical groundwater movement and contaminant transport (RMRS, 1996a).

1.2.4 Hydrogeology

This section presents the basic concepts about the hydrogeologic conditions at the Site that affect groundwater monitoring and protection. Characterization of the hydrogeologic setting is based on the currently accepted conceptual geologic and hydrogeologic models described in the Sitewide Geoscience Characterization Study (EG&G, 1995a; 1995b; 1995c). These conceptual geologic and hydrogeologic models are used to predict the direction and rate of groundwater flow, identify potential pathways for contaminant migration, and determine the extent of contaminant plumes given varying physical, chemical, and biological factors.

1.2.4.1 Definition of the Uppermost Aquifer for the Site

The term *aquifer* as defined by 40 CFR Section 260.10 is a "geologic formation, group of formations, or a part of a formation that is capable of yielding a significant amount of water to a well or spring." An *uppermost aquifer* is also defined as "the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's boundary." Geologic materials with similar hydrologic properties comprise a hydrostratigraphic unit (HSU) (Fetter, 1988). For purposes of this report, the uppermost aquifer or upper hydrostratigraphic unit (UHSU) consists of the unconfined saturated zone, in which unconsolidated and consolidated groundwater-bearing strata are in hydraulic communication. The UHSU consists of the following geologic units: Rocky Flats Alluvium, valley-fill alluvium, colluvium, landslide deposits, weathered



Structural interpretation from EG&G, 1995a.

Figure 1-4
Generalized Geologic Cross Section of the Front Range and the Rocky Flats Area

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Arapahoe and Laramie Formation bedrock, and all sandstones within the Arapahoe and upper Laramie Formations in hydraulic communication with the overlying unconsolidated surficial deposits. The UHSU is considered to be equivalent to the uppermost aquifer at the Site.

Beneath the surficial materials and the consolidated sandstones of the UHSU are the geologic units of the lower hydrostratigraphic unit (LHSU). The LHSU consists of the consolidated, unweathered bedrock zone of the Arapahoe and upper Laramie Formations not in hydraulic communication with the overlying UHSU. The Arapahoe and upper Laramie Formations comprising the geologic units of the LHSU consist of lesser amounts of sandstone and greater amounts of adjacent claystones. Because of the low permeability of the claystones, they behave as aquitards restricting hydraulic communication with the UHSU. The lower Laramie and Fox Hills Sandstone Formations comprise a stratigraphically lower and third hydrostratigraphic unit beneath the site. Groundwaters of the three hydrostratigraphic units are hydraulically separated beneath the IA. They do converge, however, and are in mutual contact immediately upgradient near the western margin of the Site due to monoclinal folding and erosional proximity. Initially, background geochemical characterization of the UHSU and LHSU revealed that these units have statistically different groundwater chemistry concluding with the delineation of separate hydrostratigraphic units (EG&G, 1993a). In addition, possible communication of the hydrostratigraphic units along other geologic structures is currently being assessed. More detailed differentiation of the LHSU will be achieved as new hydrogeologic and geochemical data are generated from Site investigations currently proposed or in progress.

1.2.4.2 Groundwater Occurrence and Distribution

The Site is located in a regional groundwater recharge area (EG&G, 1991a). Groundwater recharge occurs from the infiltration of incident precipitation and as base flow near the upgradient area of the Site drainage basin that extends west to Coal Creek. Groundwater recharge occurs from the infiltration of precipitation and from stream, ditch, and pond seepage. Much of the groundwater that discharges from the UHSU to streams and seeps evaporates as it is being discharged. Limited investigation of the former OU2 area during the period of July through October 1993 indicated that the precipitation component of recharge was lost to evapotranspiration demands (EG&G, 1993b).

In the western part of the Site, where the thickness of the Rocky Flats Alluvium reaches 100 feet, the depth to the water table is 50 to 70 feet below the surface. The depth to water generally becomes shallower from west to east as the alluvial material thins and the confining claystones are closer to the ground surface. At the head of stream drainages and along valley sides, seeps are common at the base of the Rocky Flats Alluvium where it is in contact with claystones of the Arapahoe/Laramie Formations, and where the Arapahoe Formation sandstone crops out. In general, the unconsolidated surficial materials are thicker in the western, higher elevations at the Site. Accordingly, the saturated thickness of these materials also thins eastward. The potentiometric surface of groundwater in unconsolidated surficial deposits has been mapped and is shown on Plates 2 and 3. The periods illustrated represent the times of year when static water levels are expected to be both high and low. Areas of unsaturated and seasonally unsaturated alluvium and colluvium are indicated east and northeast of the IA.

Groundwater in the Arapahoe Formation sandstone units, which subcrop beneath the alluvial material, is not confined when in contact with the surficial materials. In this setting, a hydraulic connection exists between the bedrock sandstone and the alluvial material allowing the bedrock groundwater to exist under unconfined conditions as part of the UHSU. The subcropping Arapahoe Formation No. 1 Sandstone, located in the eastern portion of the IA and in the area between South Walnut Creek and Woman Creek, is part of the UHSU (EG&G, 1991a). The upper discontinuous sandstones of the Laramie Formation also subcrop beneath alluvium and colluvium, but in limited areas in the valleys and along valley slopes. Groundwater in the lenticular sandstone units of the Laramie Formation occurs under confined conditions over scattered areas of the Site.

Groundwater levels in UHSU wells fluctuate in response to seasonal recharge events. Approximately 15 percent of the groundwater monitoring wells are commonly dry during at least one of the quarterly sampling events. Of the remaining wells, approximately half cannot yield sufficient water volume (4.5 gallons) necessary for a full suite of laboratory samples. Sampling crews must return later after wells have recovered to obtain additional sample volumes.

1.2.4.3 Groundwater Flow

The shallow groundwater flow regime at the Site is illustrated by the configuration of potentiometric contours in Plates 2 and 3. These maps indicate that groundwater flow is largely controlled by the topography of the bedrock surface. Groundwater in the ridge tops generally flows toward the east-northeast. In areas where the ridge tops are dissected by east-northeast trending stream drainages, groundwater flows to the north or south toward the bottom of the valleys. In the valley bottoms, groundwater flows to the east, generally following the course of the stream. Shallow groundwater flow is primarily lateral due to the low permeability of the underlying claystone bedrock.

A potential for vertical groundwater flow, although limited by the low permeability of bedrock claystones, is indicated by the presence of strong downward vertical hydraulic gradients between the

UHSU and underlying bedrock units. This situation implies a condition of poor hydraulic communication. For example, vertical gradients on the order of 0.79 to 1.05 ft/ft have been calculated between colluvial and bedrock sandstones. The vertical groundwater flux through claystones is assumed to be small, on the order of 10^{-10} to 10^{-7} cm/sec, based on calculations provided in RMRS (1996a). Fracturing, where evident, is most abundant in the weathered bedrock zone, but is observed to decrease with depth in unweathered bedrock. Preferential vertical groundwater flow and contaminant transport along fractures or fault zones does not appear to represent a viable pathway for contaminant migration based on an assessment of available data (RMRS, 1996a).

1.2.4.4 Hydraulic Conductivity

The UHSU at the Site has a relatively low to moderate hydraulic conductivity that typically yields small amounts of water to groundwater monitoring wells. The UHSU exhibits a wide-range of hydraulic conductivities because of the diverse nature of the individual geologic units that comprise this unit. Summary statistics for UHSU hydraulic conductivities (EG&G, 1995c, Table G-2) indicate a range of 5.0×10^{-2} cm/sec to 3×10^{-8} cm/sec. Listed in order of decreasing geometric mean hydraulic conductivity, the relative ranking of individual units of the UHSU is presented as follows: valley-fill alluvium (2.5×10^{-3} cm/sec); Arapahoe No. 1 sandstone (7.9×10^{-4} cm/sec); Rocky Flats Alluvium (2.1×10^{-4} cm/sec); colluvium (9.3×10^{-5} cm/sec); weathered Laramie Formation sandstones (3.9×10^{-5} cm/sec); and weathered Laramie Formation claystones (8.8×10^{-7} cm/sec).

Hydraulic conductivities for LHSU materials are generally the lowest measured at the Site with geometric mean values for individual lithologic groups ranging from 1.6×10^{-7} to 5.8×10^{-7} cm/sec (EG&G, 1995c, Table G-2). The low permeability and 600+ foot thickness of the upper Laramie Formation claystones act as an effective aquitard that restricts downward vertical groundwater flow and contaminant transport to the Laramie-Fox Hills aquifer (RMRS, 1996a).

In summary, the following major geologic and hydrologic parameters influence groundwater flow at the Site (EG&G, 1995a; 1995b):

(1) Topography controls the surface waters of the upslope drainage basin which in part recharges groundwater and the three principal streams draining the Site. The majority of shallow groundwater is intercepted by these drainages.

(2) The lithology and permeability of the unconsolidated surficial deposits permit meteoric waters to recharge the water table. The water table is contained in alluvium and weathered bedrock.

(3) Paleotopography of the bedrock pediment, which is less permeable than the overlying

unconsolidated surficial deposits, serves to focus groundwater movement along bedrock "lows."

(4) Paleoweathering of shallow bedrock materials has enhanced the permeability of the upper 10 to 60 feet relative to unweathered bedrock.

The permeability of bedrock units, composed primarily of claystone with lesser amounts of siltstone and sandstone, is generally several orders of magnitude less than for unconsolidated surficial deposits. The 600+ feet of unweathered bedrock between the shallow groundwater flow system and deep regional Laramie-Fox Hills aquifer provides an effective barrier to vertical groundwater and contaminant movement.

1.3 Environmental History

Processing and fabrication of weapons-related components began at the Site in 1952 and continued through 1989. Fabrication of stainless steel components continued, however, in one building through the early 1990's. During operation, environmental protection measures were established that seemed consistent with prudent environmental management. However, some activities resulted in the environmental contamination of portions of the Site. Efforts to document the extent of Site contamination are in progress, in accordance with the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the RFCA, a cooperative agreement between U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and Colorado Department of Public Health and Environment (CDPHE). In addition, a historical release report (HRR) (DOE, 1992a) has been developed that documents knowledge gained to date about contamination arising from past practices. The HRR is updated on an annual basis with the knowledge gained from ongoing monitoring and investigative activities on site. The additional information is submitted on an annual basis to the EPA and CDPHE as addenda to the original document.

Documented areas of soil contamination have been designated as Individual Hazardous Substance Sites (IHSSs). Many of these IHSSs have been characterized as part of the Remedial Investigation/Feasibility Study (RI/FS) process which was conducted under the Interagency Agreement (IAG, 1991) between DOE, CDPHE and EPA. Some IHSSs have already been remediated and others are currently scheduled for excavation and treatment by the Environmental Restoration Department in accordance with a Site environmental remediation priority ranking system.

Groundwater investigations at the Site have determined that some IHSSs have released hazardous and radionuclide contaminants to groundwater. The most widespread contamination is that of volatile organic compounds (VOCs). Plate 10 shows the distribution of VOC contamination in the UHSU. Plume definition is inexact however, because of limitations in well coverage, variability of hydrostratigraphic conditions, and local variations in groundwater transport velocity. Previously published plume maps for individual constituents can be found in the 1993 Well Evaluation Report (EG&G, 1994a), the annual RCRA Groundwater reports (EG&G, 1992, 1993c, 1994b, 1995d; RMRS/KH, 1996) and in individual OU RI/RFI reports.

Compared to all other contaminants, groundwater VOC plumes at RFETS have the greatest potential to impact surface water, based on spatial distribution and concentration considerations. These plumes have been defined on the basis of concentration values above the RFCA Tier II Action Level for individual constituents. Action levels at RFETS are derived from and are similar to regulated maximum concentration limits (MCLs). To delineate areas of highly contaminated groundwater, the Tier I groundwater action levels of 100 x Tier II Action Levels were compared against all groundwater data for the most common VOCs in groundwater. Values above Tier I and Tier II Action Levels were plotted and are shown on Plate 10. The most probable sources were identified using the results of recent field sampling programs and correlating this with our knowledge of Site processes (see RMRS, 1996b). A flow diagram (RMRS, 1996b) illustrates the method used to locate the contaminant plumes and corresponding sources, and to assist in determining which areas should be evaluated for potential remedial action. Other contaminants will also be addressed where there is a potential impact to surface water above action levels.

Six VOC groundwater contaminant plumes have been identified where contaminant concentrations are above Tier I Action Levels. These groundwater contaminant plumes include the IHSS 119.1 Plume, Mound Plume, 903 Pad and Ryan's Pit Plume, Carbon Tetrachloride Plume, East Trenches Area Plume, and Industrial Area Plume. In addition, there are two plumes with contaminant concentrations above Tier II Action Levels that have the potential to impact surface water. These plumes are the Present Landfill and the Property Utilization and Disposal (PU&D) Yard (RMRS, 1996b).

In addition to the VOC plumes, there are other constituents with concentrations above action levels in groundwater. Evaluation of metals anomalies has been curtailed pending re-evaluation of background thresholds that will be done in FY99.

1.3.1 Rocky Flats Cleanup Agreement

The RFCA was officially adopted on July 19, 1996 (RFCA, 1996). The RFCA replaces the IAG as the environmental cleanup agreement for RFETS. The RFCA outlines the goals, objectives, and strategies that will lead to the RFETS cleanup and closure mission objectives. The Action Level Framework (ALF) attachment to the RFCA contains specific requirements for environmental monitoring and reporting, and it sets action levels for contaminant concentrations in groundwater and in other media. The IMP is required under RFCA to further define the monitoring programs for the Site.

To align the groundwater monitoring program with the new RFETS mission and RFCA requirements, the monitoring network was evaluated in 1996. A data quality objective (DQO) process was used to determine what decisions were necessary for groundwater and the function of each well in the network in supporting those decisions. DOE, CDPHE, EPA, and stakeholders were directly involved in decisions involving the monitoring network. Results of this evaluation are presented in the IMP which is discussed below.

1.3.2 Integrated Monitoring Plan for Groundwater

The Integrated Monitoring Plan (IMP) is a summary document that outlines the goals for groundwater monitoring (and other environmental media), and describes the various components of the groundwater monitoring program (K-H, 1998a). To evaluate groundwater monitoring needs, one must know the RFCA ALF for groundwater, the Site history and areas of contamination, the physical and hydrogeologic setting of the Site, the effect of contaminated areas on groundwater, and the nature of the groundwater contaminant plumes. This information is presented in the IMP Background Document (K-H, 1998b). Appendices A, B, C, and D of the groundwater section of the Background Document cover these previous topics. Appendix E of the groundwater section lists the wells that will be monitored for water quality or for groundwater flow.

In the past, two plans have been required at RFETS to comply with DOE Order 5400.1 (DOE, 1988, Page III-2), a Groundwater Protection & Management Program Plan and a Groundwater Monitoring Plan. These two plans have historically been combined into one document, the Groundwater Protection and Monitoring Program Plan (GPMPP) (EG&G, 1993d), which defines and describes the groundwater protection and monitoring programs at the Site. In addition, an assessment groundwater monitoring plan was required under RCRA for the interim status units on Site. This Plan is called the Groundwater Assessment Plan (GWAP) (DOE, 1993a). Other monitoring plans have been developed to address groundwater monitoring requirements as outgrowths of various CERCLA Interim Measure/Interim Remedial Action (IM/IRA) decision documents. The IMP will serve as the Groundwater Monitoring Plan for the Site, and it will replace the requirements found in the group of plans named above. It will also revise the requirements of the routine groundwater monitoring portion of the IA IM/IRA decision document (DOE, 1994) and the French Drain Performance Monitoring Plan (DOE, 1992b).

The original IMP was published in May 1997. The IMP and IMP Background Document are updated annually with any changes to the monitoring programs

The groundwater monitoring network, as defined in the IMP (K-H, 1998a), has eight categories of monitoring wells. Table 1-1 lists the wells in the current monitoring program. Table 1-2 presents the analytical suites associated with each well in the program. The decision rules presented in the original IMP have been retained for determining Tier I and II exceedances of groundwater Action Levels. The well types and decision rules are defined below:

Boundary (B) Monitoring Wells

These wells monitor groundwater leaving the eastern Site boundary. A reportable exceedance occurs if a measured concentration is above a Tier II action level **and** the background Mean plus 2 Standard Deviations (M2SDs). When there are no previous historical data, **or** a value is greater than the M2SD of the historical concentration in the well when there have been historical exceedances of Tier II action levels, the required action is to initiate monthly sampling. Appropriate parties (DOE, CDPHE and EPA) are notified and possible impacts to surface water are evaluated if contaminant levels are above action levels, by the above criteria, for three consecutive months.

D&D (DD) Monitoring Wells

These wells monitor for releases to groundwater from decontamination and decommissioning (D&D) activities. A concentration value is reportable when a measured concentration is above the M2SD of the established historical baseline concentration downgradient of the building(s). The required action is to inform appropriate parties and initiate an evaluation of the situation.

Plume Definition (PD) Monitoring Wells

These wells are located within known contaminant plumes and are above Tier II action levels, but are below the Tier I action levels established in the ALF. A value is reportable when a measured concentration is above a Tier I action level, **and** the background M2SD, **and** the M2SD of the historical concentration in the well. The required action is to reclassify as a Tier I reportable well and evaluate possible impacts to groundwater.

Plume Extent (PE) Monitoring Wells

These wells are located at the edges of known groundwater contaminant plumes, along pathways to surface water. These wells monitor for an increase in concentrations that may result in future impacts to surface water. A value is reportable if a measured concentration is above a Tier II action level **and** the

TABLE 1-1
GROUNDWATER MONITORING WELLS

WELL NO	REQUENC	CLASS	PLUME\AREA	DRIVERS	ORMATIO	PURPOSE
5387	Semiannual	PE	881 Hillside	RFCA	AL	Plume Extent south of the 881Hillside Plume
4887	Semiannual	PE	881 Hillside	RFCA	AL	Plume Extent south of the 881 Hillside Plume
4787	Semiannual	PE	881 Hillside	RFCA	AL	Plume Extent south of the 881 Hillside Plume
00797	Semiannual	PM	881 Hillside	RFCA	AL	Performance Monitoring for 881 Footing Drain Sump
11092	Semiannual	PM	881 Hillside	FCA, IM/IRA -F	AL	Performance Monitoring for the French Drain
10992	Semiannual	PM	881 Hillside	FCA, IM/IRA -F	AL	Performance Monitoring for the French Drain
10792	Semiannual	PM	881 Hillside	FCA, IM/IRA -F	AL	Performance Monitoring for the French Drain
10692	Semiannual	PM	881 Hillside	FCA, IM/IRA -F	AL	Performance Monitoring for the French Drain
10592	Semiannual	PM	881 Hillside	FCA, IM/IRA -F	AL	Performance Monitoring for the French Drain
0487	Semiannual	PD	881 Hillside	RFCA	AL	Plume Definition well for the 881 Hillside Plume
91COLGA	Quarterly	PM	881 Hillside	RFCA/IMIRA -FD	NA	Performance Monitoring of groundwater in collection sump in French Drain
91COLWE	Quarterly	PM	881 Hillside	RFCA/IMIRA -FD	AL	Performance Monitoring of groundwater in collection well on 881 Hillside
SW13494	Quarterly	PM	881 Hillside	RFCA/IMIRA -FD	NA	Performance Monitoring of groundwater in footing drain seep below Bldg. 881
6386	Semiannual	PD	903 Pad	RFCA	AL	Plume Definition well monitoring pathway to Woman Cr. in the 903 Pad/Ryans Pit Pl
6286	Semiannual	PD	903 Pad	RFCA	BD/USHU	Plume Definition well monitoring pathway to Woman Cr. in the 903 Pad/Ryans Pit P
3087	Semiannual	PD	903 Pad	RFCA	BD	Plume Definition well monitoring pathway to Woman Cr. in the 903 Pad/Ryans Pit Pl
2987	Semiannual	PD	903 Pad	RFCA	AL	Plume Definition well monitoring pathway to Woman Cr. in the 903 Pad/Ryans Pit Pl
23196	Semiannual	PE	903 Pad	RFCA	AL	Plume Extent well monitoring the southward migration of the Ryans Pit/903 Pad Plum
23096	Semiannual	PE	903 Pad	RFCA	AL	Plume Extent well monitoring the southern migration of the Ryans- OU2 VOA Plume
07391	Semiannual	PM	903 Pad	RFCA	AL\BD	Performance Monitoring well monitoring effects of remediation downgradient of Ryan
00491	Semiannual	PD	903 Pad	RFCA	BD\UHSU	Plume Definition well monitoring the 903 Pad VOC Plume
02297	Semiannual	DD	Bldg 779	FCA, IM/IRA for I	AL	D&D monitoring downgradient of Bldg. 779
02497	Semiannual	DD	Bldg 779	FCA, IM/IRA for I	AL	D&D monitoring downgradient of Bldg. 779
02397	Semiannual	DD	Bldg 779	FCA, IM/IRA for I	AL	D&D monitoring upgradient of Bldg. 779
22996	Semiannual	DD	Bldg 886	FCA, IM/IRA for I	AL	Building D&D well monitoring potential rad contamination near 886 lab
10198	Semiannual	DD	Bldg. 123	RFCA -IM/IRA	AL	D & D Monitoring for Building 123 D&D
10298	Semiannual	DD	Bldg. 123	RFCA -IM/IRA	AL	D & D Monitoring for Building 123 D&D
10398	Semiannual	DD	Bldg. 123	RFCA -IM/IRA	AL	D & D Monitoring for Building 123 D&D
10498	Semiannual	DD	Bldg. 123	RFCA -IM/IRA	AL	D & D Monitoring for Building 123 D&D
10598	Semiannual	DD	Bldg. 123	RFCA -IM/IRA	AL	D & D Monitoring for Building 123 D&D
41691	Semiannual	B	Boundary	RFCA, AIP	AL	Boundary Well - in the Walnut Cr. Drainage at the Indiana Street Boundary
41591	Semiannual	B	Boundary	RFCA, AIP	AL	Boundary Well - in small drainage near east access gate
10394	Semiannual	B	Boundary	RFCA, AIP	AL	Boundary Well - in the Woman Cr. Drainage at the Indiana Street Boundary
10294	Semiannual	B	Boundary	RFCA, AIP	AL	Boundary Well - in drainage below Pond D-2 in the southeast corner of the Site
06491	Semiannual	B	Boundary	RFCA, AIP	BD/UHSU	Boundary Well - in small drainage east of the Site at Indiana St.
0386	Semiannual	B	Boundary	RFCA, AIP	BD/UHSU	Boundary Well - in small drainage north of the east access gate
P219189	Semiannual	PD	Carbon Tet	RFCA, RCRA	AL	Plume Definition well for VOC contamination comming from Carbon Tet Plume
P209389	Semiannual	PD	Carbon Tet	RFCA, RCRA	BD	Plume Definition well in the Carbon Tet Plume
P209289	Semiannual	PD	Carbon Tet	RFCA, RCRA	AL	Plume Definition well in the Carbon Tet Plume
12191	Semiannual	PM	East Tranches	RFCA	BD\UHSU	Performance Monitoring at edge of T3 soil excavation
23296	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the northern migration of the East Trenches Area Plum
10194	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the southern migration of the East Trenches Plume
06091	Semiannual	PE	East Trenches	RFCA	AL/BD	Plume Extent well monitoring the northeast migration of the East Trenches Plume
05091	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the eastward migration of the East Trenches Plume
04991	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the eastward migration of the East Trenches Plume
04591	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the southward migration of the East Trenches Plume
04091	Semiannual	PE	East Trenches	RFCA	AL	Plume Extent well monitoring the northward migration of the East Trenches Plume
03991	Semiannual	PD	East Trenches	RFCA	AL	Plume Definition well monitoring the East Trenches Plume
11891	Semiannual	PM	East Trenches	RFCA	BD\UHSU	Performance Montoring well monitoring effects of remediation downgradient of Trenc
3687	Semiannual	PM	East Trenches	RFCA	BD\USHU	Performance Monitoring well monitoring effects of remediation downgradient of Trenc
12691	Semiannual	PM	East Trenches	RFCA	BD\USHU	Performance Monitoring well monitoring effects of remediation downgradient of Trenc

PE = Plume Extent Wells
PD = Plume Definition Wells
PM = Performance Monitoring Wells
B = Boundary Wells
D = Drainage Wells
DD = D D Monitoring Wells

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TABLE 1-1
GROUNDWATER MONITORING WELLS

05691	Semiannual	PM	East Trenches	RFCA	AL	Performance Monitoring well monitoring effects of remediation downgradient of Trenc
05391	Semiannual	PD	East Trenches	RFCA	AL	Plume Definition *well monitoring* eastward concentration of VOCs from the East Tren
10994	Semiannual	PE	IA\Old Landfill	RFCA	AL	Plume Extent IA VOA Plume\Old Landfill Plume near Woman Cr.
7086	Semiannual	PE	IA\Old Landfill	RFCA	AL	Plume Extent well monitoring IA Plume and Old Landfill Plume pathway in Woman Cr
P416889	Semiannual	PD	Ind. Area	FCA, IM/IRA for I	AL	Plume Definition of IA Plume south of Bldg. 664 along pathway to Woman Cr.
P416789	Semiannual	PD	Ind. Area	FCA, IM/IRA for I	AL	Plume Definition of IA Plume south of 400 area along pathway to Woman Cr.
P416689	Semiannual	PE	Ind. Area	FCA, IM/IRA for I	AL	Plume Extent to monitor southern migration of IA Plume south of Bldg. 440
P314289	Semiannual	PE	Ind. Area	FCA, IM/IRA for I	AL	Plume Extent to monitor the southern migration of IA Plume near Bldg. 850
P313589	Semiannual	PE	Ind. Area	FCA, IM/IRA for I	AL	Plume Extent to monitor the eastward migration of IA Plume near Bldg. 881
P114389	Semiannual	PE	Ind. Area	RFCA	AL	Plume Extent well to monitor extent of PU&D yard plume pathway to Walnut Cr.
6186	Semiannual	PE	Ind. Area	FCA, IM/IRA for I	AL	Plume Extent well monitoring easward migration of IA Plume
43392	Semiannual	PE	Ind. Area	RFCA	AL	Plume Extent well monitoring southward migration of IA Plume
22896	Semiannual	PE	Ind. Area	FCA, IM/IRA for I	AL	Plume Extent well monitoring the northward migration of IA VOA Plume
22796	Semiannual	PE	Ind. Area	FCA, IM/IRA for I	AL	Plume Extent well monitoring the northward migration of Carbon Tet Plume
22696	Semiannual	PE	Ind. Area	FCA, IM/IRA for I	AL	Plume Extent well monitoring the westward migration of the Carbon Tet Plume
22596	Semiannual	PE	Ind. Area	FCA, IM/IRA for I	AL	Plume Extent well monitoring the northern migration of the IA Plume
2186	Semiannual	PE	Ind. Area	RFCA	BD/UHSU	Plume Extent well monitoring the northern migration of the 'IA Plume
1986	Semiannual	PE	Ind. Area	RFCA	AL	Plume Extent well monitoring the northern migration of the IA PLume
B206989	Quarterly	RCRA	Landfill	RFCA, RCRA	BD/UHSU	RCRA\Plume Extent well monitoring downgradient of Landfill Plume
77392	Semiannual	PD	Landfill	RFCA, RCRA	AL	Plume Definition well monitoring the eastward migration of the PU&D Yard Plume
52994	Quarterly	RCRA	Landfill	RFCA, RCRA	AL	RCRA/Plume Extent well monitoring downgradient of Landfill Plume
52894	Quarterly	RCRA	Landfill	RFCA, RCRA	AL	RCRA/Plume Extent well monitoring downgradient of Landfill Plume
4087	Quarterly	RCRA	Landfill	RFCA, RCRA	AL	RCRA/Plume Extent well monitoring downgradient of Landfill Plume
02291	Semiannual	PM	Mound	RFCA	BD/UHSU	Performance Monitoring on the Mound Source remediation
00897	Semiannual	PM	Mound	RFCA	BD/UHSU	Performance Monitoring on the Mound Source remediation
3586	Semiannual	PE	Mound	RFCA	AL	Plume Extent well tracking migration of Solar Ponds nitrate Plume
75992	Semiannual	PE	ound\E. Trenc	RFCA	AL	Plume Extent well monitoring So. Walnut Cr. Drainage below Mound Site Plume
08091	Semiannual	PE	ound\E. Trenc	RFCA	AL	Plume Extent well monitoring the southern migration of Mound and East Trenches P
6486	Semiannual	D	NA	RFCA	AL	Drainage well monitoring the Woman Cr. drainage downgradient of the 881 Hillside
5587	Semiannual	D	NA	RFCA	AL	Drainage well monitoring the Woman Cr. drainage south of the 881 Hillside Plume
38591	Semiannual	D	NA	RFCA	AL	Drainage well in Woman Cr. Drainage below 881 Hillside Plume
6586	Semiannual	D	NA	RFCA	AL	Drainage well monitoring the No. side Woman Cr. below 903Pad/Ryans Pit Plume
00997	Semiannual	D	NA	RFCA	AL	Drainage Well - below Pond B-4 in South Walnut Creek Drainage
1386	Semiannual	D	NA	RFCA	AL	Plume Definition well monitoring the migration of the SEP Nitrate and Carbon Tet Pl
00197	Semiannual	PE	Old Landfill	RFCA	AL	Plume Extent well monitoring the Industrial Area Plume
00397	Semiannual	PE	PU&D	RFCA	AL	Plume Extent well monitoring the PU&D Yard Plume
02197	Semiannual	PE	PU&D	RFCA	AL	Plume Extent well monitoring the PU&D Yard Plume
70493	Quarterly	RCRA	PU&D	RFCA, RCRA	BD/UHSU	RCRA upgradient/Plume Definition well monitoring the edge of the PU&D Yard Plum
70393	Quarterly	RCRA	PU&D	RFCA, RCRA	AL	RCRA upgradient /Plume Definition well monitoring the edge of the PU&D Yard Plum
70193	Quarterly	RCRA	PU&D	RFCA, RCRA	BD/UHSU	RCRA upgradient/Plume Extent well monitoring the PU&D Yard Plume
5887	Quarterly	RCRA	PU&D	RFCA, RCRA	AL	RCRA upgradient/ Plume Extent Well monioring the PU&D Yard Plume - LF
76992	Semiannual	PE	PU&D\Landfill	RFCA, RCRA	AL	Plume Extent well monitoring the eastward migration of the PU&D Yard/Landfill Plum
00597	Semiannual	PD	PU&D\Landfill	RFCA, RCRA	AL	Plume Definition well monitoring the Landfill/PU&D yard Plume
00297	Semiannual	PD	Solar Ponds	RFCA	AL	Plume Definition well monitoring the southern migration of the Solar Ponds Plume
P219489	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Extent well monitoring the northern migration of the SEP Nitrate Plume
P218389	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Extent well monitoring the northern migration of the SEP Nitrate Plume
B208289	Semiannual	PE	Solar Ponds	RFCA	BD/UHSU	Plume Extent well monitoring the northeast mitgration of the SEP Nitrate Plume
3386	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Extent well monitoring the southern migration of the SEP Nitrate and Carbon
1786	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Definition well monitoring the migration of the SEP Nitrate and Carbon Tet Pl
B208789	Semiannual	PE	Solar Ponds	RFCA	AL	Plume Extent well monitoring the northeast mitgration of the SEP Nitrate Plume
P209489	Semiannual	PD	Solar Ponds	RFCA	BD\UHSU	Plume Definition well for the Carbon Tet. Plume

PE = Plume Extent Wells
PD = Plume Definition Wells
PM = Performance Monitoring Wells
B = Boundary Wells
D = Drainage Wells
DD = D D Monitoring Wells

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TABLE 1-2
MONITORING WELL SAMPLE SUITES

WELLNO	FREQUENCY	PLUME\AREA	VOC Suite	METALS Suite	TRITIUM	PU/AM	SR 89/90	URANIUM	NITRATE	FLUORIDE	SULPHATE	CYANIDE	CESIUM	CHLORIDE	SULFIDE	DOC/TOC	METHANE
891COLWEL	Quarterly	881 Hillside	X	X				X									
SW13494	Quarterly	881 Hillside	X	X				X									
5387	Semiannual	881 Hillside	X	X				X	X		X						
4887	Semiannual	881 Hillside	X	X				X	X		X						
4787	Semiannual	881 Hillside	X	X				X	X		X						
00797	Semiannual	881 Hillside	X	X				X	X		X						
11092	Semiannual	881 Hillside	X	X				X	X		X						
10992	Semiannual	881 Hillside	X	X				X	X		X						
10792	Semiannual	881 Hillside	X	X				X	X		X						
10692	Semiannual	881 Hillside	X	X				X	X		X						
10592	Semiannual	881 Hillside	X	X				X	X		X						
0487	Semiannual	881 Hillside	X	X				X	X		X						
891COLGAL	Quarterly	881 Hillside	X	X				X									
6386	Semiannual	903 Pad	X	X		X		X	X		X						
6286	Semiannual	903 Pad	X	X		X		X	X		X						
3087	Semiannual	903 Pad	X	X		X		X	X		X						
2987	Semiannual	903 Pad	X	X		X		X	X		X						
23196	Semiannual	903 Pad	X	X		X		X	X		X						
23096	Semiannual	903 Pad	X	X		X		X	X		X						
07391	Semiannual	903 Pad	X	X		X		X	X		X						
00491	Semiannual	903 Pad	X	X		X		X	X		X						
02297	Semiannual	Bldg 779	X	X		X		X	X								
02497	Semiannual	Bldg 779	X	X		X		X	X								
02397	Semiannual	Bldg 779	X	X		X		X	X								
22996	Semiannual	Bldg 886	X	X		X	X	X									
10198	Semiannual	Bldg. 123	X	X		X		X	X			X	X				
10298	Semiannual	Bldg. 123	X	X		X		X	X			X	X				
10398	Semiannual	Bldg. 123	X	X		X		X	X			X	X				
10498	Semiannual	Bldg. 123	X	X		X		X	X			X	X				
10598	Semiannual	Bldg. 123	X	X		X		X	X			X	X				
41691	Semiannual	Boundary	X	X	X	X	X	X	X	X	X						
41591	Semiannual	Boundary	X	X	X	X		X	X	X	X						
10394	Semiannual	Boundary	X	X	X	X	X	X	X	X	X						
10294	Semiannual	Boundary	X	X	X	X		X	X	X	X						
06491	Semiannual	Boundary	X	X	X	X		X	X	X	X						
0386	Semiannual	Boundary	X	X	X	X		X	X	X	X						
P219189	Semiannual	Carbon Tet	X	X	X	X	X	X	X	X	X						
P209389	Semiannual	Carbon Tet	X	X	X	X	X	X	X	X	X						
P209289	Semiannual	Carbon Tet	X	X	X	X	X	X	X	X	X						
1386	Semiannual	Drainage	X	X	X	X	X	X	X	X	X						
6486	Semiannual	Drainage	X	X			X	X	X		X						
5587	Semiannual	Drainage	X	X			X	X	X		X						
38591	Semiannual	Drainage	X	X			X	X	X		X						
6586	Semiannual	Drainage	X	X		X		X	X								
00997	Semiannual	Drainage	X	X		X	X	X									
23296	Semiannual	East Trenches	X	X		X		X	X								
10194	Semiannual	East Trenches	X	X		X		X	X								
06091	Semiannual	East Trenches	X	X		X		X	X								
05091	Semiannual	East Trenches	X	X		X		X	X								
04991	Semiannual	East Trenches	X	X		X		X	X								
04591	Semiannual	East Trenches	X	X		X		X	X								
04091	Semiannual	East Trenches	X	X		X		X	X								
03991	Semiannual	East Trenches	X	X		X		X	X								
11891	Semiannual	East Trenches	X	X		X		X	X								

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TABLE 1-2
MONITORING WELL SAMPLE SUITES

WELLNO	FREQUENCY	PLUME\AREA	VOC Suite	METALS Suite	TRITIUM	PU/AM	SR 89/90	URANIUM	NITRATE	FLUORIDE	SULPHATE	CYANIDE	CESIUM	CHLORIDE	SULFIDE	DOC/TOC	METHANE
3687	Semiannual	East Trenches	X	X		X		X	X								
12691	Semiannual	East Trenches	X	X		X		X	X								
05691	Semiannual	East Trenches	X	X		X		X	X								
05391	Semiannual	East Trenches	X	X		X		X	X								
12191	Semiannual	East Trenches	X	X		X		X	X								
10994	Semiannual	IA\Old Landfill	X	X			X	X	X		X						
7086	Semiannual	IA\Old Landfill	X	X			X	X	X		X						
P416889	Semiannual	Ind. Area	X	X		X		X	X								
P416789	Semiannual	Ind. Area	X	X		X		X	X								
P416689	Semiannual	Ind. Area	X	X		X		X	X								
P314289	Semiannual	Ind. Area	X	X		X		X	X								
P313589	Semiannual	Ind. Area	X	X		X		X	X								
P114389	Semiannual	Ind. Area	X	X		X		X	X								
6186	Semiannual	Ind. Area	X	X		X		X	X								
43392	Semiannual	Ind. Area	X	X		X		X	X								
22896	Semiannual	Ind. Area	X	X		X		X	X								
22796	Semiannual	Ind. Area	X	X		X		X	X								
22696	Semiannual	Ind. Area	X	X		X		X	X								
22596	Semiannual	Ind. Area	X	X		X		X	X								
2186	Semiannual	Ind. Area	X	X		X		X	X								
1986	Semiannual	Ind. Area	X	X		X		X	X								
B206989	Quarterly	Landfill	X	X	X			X	X	X	X						
77392	Semiannual	Landfill	X	X	X			X	X	X	X						
52994	Quarterly	Landfill	X	X	X			X	X	X	X						
52894	Quarterly	Landfill	X	X	X			X	X	X	X						
4087	Quarterly	Landfill	X	X	X			X	X	X	X						
02291	Semiannual	Mound	X	X		X		X	X								
00897	Semiannual	Mound	X	X		X		X	X								
3586	Semiannual	Mound	X	X		X		X	X								
75992	Semiannual	Mound\E. Trench	X	X		X	X	X	X								
08091	Semiannual	Mound\E. Trench	X	X		X	X	X	X								
00197	Semiannual	Old Landfill	X	X	X		X	X	X	X	X						
00397	Semiannual	PU&D	X	X	X			X	X	X	X						
02197	Semiannual	PU&D	X	X	X			X	X	X	X						
70493	Quarterly	PU&D	X	X	X			X	X	X	X						
70393	Quarterly	PU&D	X	X	X			X	X	X	X						
70193	Quarterly	PU&D	X	X	X			X	X	X	X						
5887	Quarterly	PU&D	X	X	X			X	X	X	X						
76992	Semiannual	PU&D\Landfill	X	X	X			X	X	X	X						
00597	Semiannual	PU&D\Landfill	X	X	X			X	X	X	X						
00297	Semiannual	Solar Ponds	X	X	X	X	X	X	X	X	X						
P219489	Semiannual	Solar Ponds	X	X	X	X	X	X	X	X	X						
P218389	Semiannual	Solar Ponds	X	X	X	X	X	X	X	X	X						
B208289	Semiannual	Solar Ponds	X	X	X	X	X	X	X	X	X						
3386	Semiannual	Solar Ponds	X	X	X	X	X	X	X	X	X						
1786	Semiannual	Solar Ponds	X	X	X	X	X	X	X	X	X						
B208789	Semiannual	Solar Ponds	X	X	X	X	X	X	X	X	X						
P209489	Semiannual	Solar Ponds	X	X	X	X	X	X	X	X	X						

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background M2SD. When there are no previous historical data, **or** a value is greater than the M2SD of the historical concentration in the well when there have been historical values above Tier II action levels, the required action is to initiate monthly sampling. Appropriate parties are notified and possible impacts to surface water are evaluated if contaminant levels are above action levels, by the above criteria, for three consecutive months.

Drainage (D) Monitoring Wells

These wells are located in stream drainages, downgradient of contaminant plumes. They have the same programmatic requirements as PE wells under the IMP.

A value is reportable when a measured concentration is above the Tier II action level **and** the background M2SD. When there are no historical data, **or** a value is greater than the M2SD of the historical concentration in the well when there have been historical values above Tier II action levels, the required action is to initiate monthly sampling. Appropriate parties are notified and possible impacts to surface water are evaluated if values are above action levels, by the above criteria, for three consecutive months.

Performance Monitoring (PM) Wells

These wells monitor the effect of a remediation or source removal action, as required in the ALF. If an increasing trend in the concentration of a contaminant is noted, then the appropriate parties are notified and an evaluation of the situation is initiated.

RCRA Monitoring Wells

These wells monitor downgradient groundwater contaminant concentrations at RCRA units. If the mean concentration of a contaminant in a downgradient well is greater than the mean concentration in upgradient wells **and** concentrations at the well show an upward trend with time, a report will be made to appropriate agencies and an investigation will be initiated to investigate possible causes.

Plume Degradation Monitoring Wells

These wells monitor the downgradient portions of groundwater plumes or plume sources to establish whether natural processes are degrading (also called attenuating) the nature and extent of the plume prior to entering the surface water environment. In areas where monitoring can document a natural attenuation process for a plume, other remediation activities may not be necessary. These wells would differ from plume extent wells in that the analyte suite may include parameters that focus on measuring the attenuation process. Also, these wells would not only look at concentration of contaminants but would look at the breakdown products from these contaminants in the evaluation process. If significant natural attenuation can be substantiated, then a non-remedial decision can be promulgated for the plume.

Groundwater reporting has been integrated under the IMP. Four quarterly reports are produced annually that document concentration values above RFCA Action Levels. Also documented are changes in water quality for wells not monitored for comparison to action levels. A RFCA Annual Groundwater Report is also required to summarize all actions taken for groundwater compliance within each calendar year.

For documented values above action levels and Site background in the designated monitoring wells in the program, an evaluation of impact to surface water is required. These evaluations are determined on a case by case basis depending on the data requirements necessary to do the impact analysis. Section 4.0 of this report discusses the status of the current evaluations that were implemented based on elevated concentrations in 1996.

1.3.3 Changes to the Groundwater Monitoring Program

Additions to the Groundwater Monitoring Network

Wells have been added to the Site monitoring network based on the results of groundwater evaluations and remediation activities. Plate 1 shows the locations for these monitoring wells.

The Mound plume passive treatment system was completed in FY98. This system was constructed in the area of seep location SW59 and plume extent well 3586, both of which contained detections of VOCs above Tier II action levels. A performance monitoring network will be installed in FY99 to evaluate the effectiveness of the treatment system in reducing the VOC load to South Walnut Creek.

A D&D monitoring network was established around Building 123, which was demolished in FY98. Five monitoring wells were installed and are numbered 10198 through 10598. Two of the wells were located upgradient and the other three are located downgradient of the building. These wells were also used to characterize the potential under building contamination that might be affecting groundwater at the Site

An investigation of the northern extent of the IA Plume was conducted in 1998 . Based on the results of the investigation VOC contamination was interpreted to be more extensive than previously thought. As a result, it may be necessary to re-evaluate the monitoring network in this area. Please refer to Section 4.1 for additional information on this investigation.

A real time water level monitoring network was initiated for the Site in 1998 to help qualify the affects of storm events and other recharge events on groundwater flow and transport. Twenty-five wells originally identified for water level measurements in the IMP were converted to real time monitoring stations that will record water levels six times per day. Please refer to Section 7.2 for additional information on this activity.

The sampling frequency for monitoring wells at the Present Landfill was changed from semiannual to quarterly. This change was necessary to have enough data points so that an upgradient to downgradient comparison of mean concentrations of contaminants could be calculated.

2.0 GROUNDWATER DATA QUALITY ASSESSMENT

2.1 Methods

The quality of the analytical data is assessed in terms of five data-quality parameters: precision, accuracy, representativeness, completeness, and comparability (PARCC) (EPA, 1992a). This section summarizes the types of data available to assess the PARCC parameters.

The RFETS groundwater monitoring program, as established in the IMP, consists of 98 wells that are sampled at a semi-annual frequency (K-H, 1998a). A total of 232 well sampling visits were conducted during 1998. All samples specified in the IMP were collected unless well disposition was prohibitive (i.e. dry or went dry during sampling). Table 2-1 presents a summary of sample collection and well disposition.

Quality Control (QC) samples consisting of real/duplicate pairs and rinsate samples were collected from 18 sites. The frequency for field QC sampling of 1 site in 5.4 exceeded the target rate of 1 site in 20 over the course of the 1998 sampling program. PARCC analysis of the 1998 QC data is presented in the sections that follow. Data used to evaluate the PARCC parameters are summarized in this report, and are presented in full in the quarterly monitoring reports (RMRS 1998a; 1998b; 1999a; and 1999b).

Precision

Precision is a measure of the reproducibility of analytical results. Precision is expressed quantitatively by the relative percent difference (RPD) between duplicate field samples for VOCs, metals, and water quality parameters as defined by the following equation:

$$RPD= \frac{\xi(S-D)\xi}{(S+D)/2} \times 100$$

where,

S = Sample Result
D = Duplicate or Lab Replicate Result

With respect to Radionuclides the RFETS Groundwater Program uses the following "Duplicate Error Ratio" (DER) equation:

$$DER= \frac{\xi S-D\xi}{[(TPU_S^2 + TPU_D^2)]^{1/2}}$$

where,

TPUs = total propagated uncertainty of the sample
TPU_D = total propagated uncertainty of the duplicate or lab replicate
S = sample result
D = duplicate or lab replicate result

Table 2-1
Summary of Samples Collected
Groundwater 1998

Wells	VOC's				Metals				Radiouclides																Water Quality Parameters															
									Pu/Am				U-isotopes				Tritium				Sr-89/90				NO_3/NO_2				TDS				Sulfate				Fluoride			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
00197	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D
00297	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D	D	D		D
00397	D	D		D	D	D		D	D				D	D		D	D	D		D	D				D	D		D	D	D		D	D	D		D	D	D		D
00491			S				S				S				S												S				S									
00597	S		S		S		S						S		S				S						S		S		S		S		S		S		S		S	
00797	S		S				S						S		S										S		S		S		S		S		S					
00897	S	S		S				S				S	S	S		S												S	S	S		S								
00997	S		S						S		S		S		S						S		S						S		S									
02197	S	S		S	S	S		S						S		I		S		S					S	S		S	S	S		S	S	S		S	S	S		S
02291	S	S		S				S				S	S	S		S												S	S	S		S								
02297	D	S		D	D			D	D	I		D	D	I		D	D				D				D	I		D	D	I		D	D				D			
02397	S	D		S				S	S	D		I	S	D		I									S	D		S	S	D		I								
02497	S	S		S				I	I	I		I	I	I		I									S	S		I	I	I		I	I				I			
0386	S		S						S		S		S		S		S		S						S		S		S		S		S		S		S		S	
03991			S				S				S				S												S				S									
04091	S	S		S	S	S		S	I	S		I	S	S		S									S	S		S	S	S		S				S				
04591	S		S				S		S		S		S		S										S		S		S		S									
0487	S		S	S	S		S						S		S										S		S		S		S		S		S					
04991	S	S		S	I	S		S	I	S		S	S	S		S									S	S		S	I	S		S	I				I			
05091	S		S		S		S		S		S		S		S										S		S		S		S									
05391	S		S		S		S		S		S		S		S												S		S		S									
05691	S		S		S		S		S		S		S		S										S		S		S		S									
06091	S	S		S	S	S		S	S	S		S	S	S		S									S	S		S	S	S		S								
06491	S		S						S		S		S		S				S						S		S		S		S		S		S		S		S	
07391	S		S				S		S		S		S		S												S		S		S									
08091	D	S		S	D	S		I	D	S		I	D	S		I	D				D	S		I	D	S		S	D	S		I	D				D			
10194	S		S		S		S		S		S		S		S										S		S		S		S									
10294			S						S		S		S		S		S		S						S		S		S		S		S		S		S		S	
10394			S								S				S		S			S							S				S				S				S	
10592		S		S		S		S						S		S										S		S		S		S		S		S				
10692	S		S		S		S								S										S		S		S		S		S							
10792		S		S		S		S						S		S										S		S		S		I		S		I				
10992			S				S								S												S				S				S					
10994			S				S								S								S				S				S				S					
11092		D		S		D		I						D		I										D		S		D		I		D		I				
11891	S	S		S	S	S		S	S	S		S	S	S		S									S	S		S	S	S		S								
12191	S	S		S	S	S		S	S	S		S	S	S		S									S	S		S	S	S		S								
12691	S		S		S		S		S		S		S		S										S		S		S		S									

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Table 2-1
Summary of Samples Collected
Groundwater 1998

Wells	VOC's				Metals				Radiouclides																Water Quality Parameters															
									Pu/Am				U-isotopes				Tritium				Sr-89/90				NO_3/NO_2				TDS				Sulfate				Fluoride			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1386		S		S		S	S	S		S		S		S		S		S		S		S		S		S		S		S		S		S		S		S		S
1786	S	S		S		S		S		S		S		S		S		S		S		S		S		S		S		S		S		S		S		S		S
1986	S	S		S	S	S		S				S				S												S	S	S		S								
2186		S		S		S		S				S				S												S				S								
22596			S				S																								S									
22696	S		S		S		S																								S									
22796		S		S		S		S				S				S												S				S				S				S
22896	S		S		S		S	S																					S		S									
22996	S		S						S		S		S		S								S						S		S									
23096	S		S		S		S		S		S		S		S										S		S		S		S									
23196	S	D		D	I	D		D	I	D		D	I	D		D									S	D	S	D	I	D		D	I			D	I			
23296	S		S		S		S		S		S		S		S										S		S		S		S									
2987	S	S		S		S		S		S		S		S		S										S		S		S		S				S				
3087	S	S		S		S		S	S	S		S	S	S		S									S	S		S	S	S		S			S					
3386	S	S		D		I		D	I	I		D	I	I		D	I	S		I	I	I		D		S		D	I	I		D	I	I		D	I	I		D
3586		S		S		S		S	S	S		S	S	S		S	S	S							S	S		S	S	S		S	S	S			S	S		
3687	S	S		S	S	S		S	S	S		S	S	S		S									S	S		S	S	S		S								
38591	S		D		S		D						S		D										S		D		S		D		S		D					
4087	S	S	S	D	S	S	I	D					S	S	I	D		S	I	D					S	S	I	D	S	S	I	D	S	S	I	D	S	S	I	D
41591	S		S						S		S		S		S				S						S		S		S		S		S		S		S		S	
41691	S		S						S		S		S		S		S		S						S		S		S		S		S		S		S		S	
43392			S				S																								S									
4787			D				D								D												D				D				D					
4887			S				I								I												S				I				I					
52894		S	S	D		S	S	D						S	S	D		S	S	D						S	S	D		I	S	D		I	S	D		I	S	D
52994		D	D	D		D	D	D						D	D	D		D	D	D						D	D	D		D	D	D		D	D	D		D	D	D
5387	S	S		S	S	S		S					S	S		I									S	S		S	S	S		I	S	S		I				
5587		S		D		I		D						I		D								D		S		D		I		D		I		D				
5887	S	S	S	S	S	S	S	S					S	S	S	S	S	S	S	S					S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
6186	S		S		S		S																						S		S									
6286	S		S		S		S		S		S		S		S										S		S		S											
6386	S		S		I		S		I		S		I		S										S		S													
6486	S		S	D	S		S	D					S		S										S		S		S		S		S		S					
6586			S			S	S				S				S												S				S									
70193	S	S	S	S	S	S	S	S					S	S	S	S		S	S	S					S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
70393	S	S	S	S	S	S	S	S					S	S	S	S	S	S	S	S					S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
70493	S	S	S	S	S	S	S	S					S	S	S	S		S	S	S					S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
7086	S		S		S		S						S		S						S		S		S		S		S		S		S		S					

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Table 2-1
Summary of Samples Collected
Groundwater 1998

Wells	VOC's				Metals				Radiouclides: Pu/Am				Radiouclides: U-isotopes			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
75992			S				S				S				S	
76992			S				S								S	
77392	D	S		D	D	S		D	D				D	S		D
891COLGAL		S	S	S		S	S	S						S	S	S
891COLWEL		S	S	S		S	S	S						S	S	S
B206989	S	S	S	S	S	I	I	S					I	S	I	I
B208289	S	S		S	I	S		S	I	I		I	I	I		I
B208789		S		S		S		S		S		I		S		S
P114389		S	S		S		S									
P209289		D		D		D		D		D		D		D		D
P209389	S		S		S		S		S		S		S		S	
P209489		S		S		S		S		S		S		S		S
P218389	S	S		D	S	S		D	I	S		D	I	S		D
P219189	S	S		S	I	I		I	I	I		I	I	S		I
P219489	S	S		S	I	I		I	I	I		I	I	S		I
P313589	S		S		S		S									
P314289	S		S		I		S									
P416689	S	S		S		S		S				I				I
P416789	S	S		I		S		I				I				I
416889	S	S		S	S	S		S				S				S
SW059		S				S				S				S		
SW13494		S	S	S		S	S	S						S	S	S

Wells	Radiouclides: Tritium				Radiouclides: Sr-89/90				Water Quality Parameters: NO_3/NO_2				TDS				Sulfate				Fluoride			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
75992							S				S				S									
76992							S				S				S				S				S	
77392	D	S		D	D				D	S		D	D	S		D	D	S		D	D	S		D
891COLGAL																								
891COLWEL																								
B206989	S	S	S	I					S	S	S	I	I	I	I	I	I	I	I	I	I	I	I	I
B208289	S	S		S	I	I		I	S	S		I	I	I		I	I	I		I	I	I		I
B208789		S		S				I		S		S		S		S		S		S		S		S
P114389															S									
P209289		D		D		D		D		D		D		D		D		D		D		D		D
P209389	S		S		S		S		S		S		S		S		S		S				S	
P209489		S		S				S		S		S		S		S		S		S		S		S
P218389	S	S		D	I	S		D	S	S		D	I	S		D	I	S		D	I	S		D
P219189	S	I		I	I	I		I	S	I		S	I	I		I	I	I		I	I	I		I
P219489	S	I		I	I	I		I	S	I		S	I	I		I	I	I		I	I	I		I
P313589													S		S									
P314289													I		S		I							
P416689												S		S		S								
P416789												I		S		I								
416889												S	S	S		S								
SW059																								
SW13494																								

Blank indicates no sample required or attempted.

S Indicates site was sampled.
D Indicates well was dry.
I Indicates well produced insufficient water to collect sample.

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Because TPU is only reported for Tritium (H_3) analyses in the lab reports, 2-Sigma Error has been substituted for TPU in the Uranium and Americium/Plutonium calculations made for this report.

A RPD/DER is not calculated for duplicate samples for which the analytical result for either member is qualified as undetected by the laboratory. This includes "U" qualified data for volatile organic compounds and "U" and "B" qualified data for inorganic compounds. The data flag "U" indicates that the analyte was not present above the detection limit (IDL). The data flag "B" for inorganics indicates that the value is larger than the instrument detection limit but less than the method detection limit. Results in these categories have inherently poor reproducibility and are described qualitatively.

The RPDs or DERs calculated for each real/duplicate pair having detections can be found in Table 2-2. The QC criterion for RPDs is $\leq$ 30%, for DERs the criterion is $\leq$1.96. Table 2-3 gives a summary of the overall precision compliance for RPDs and DERs.

Accuracy

Accuracy is a measure of how closely an analytical result corresponds to the "true" concentration in a sample. Accuracy, as applied to groundwater analytical data from RFETS, is described in RF/RMRS-98-200, *Evaluation of Data for Usability in Final Reports (August 1998)* as a comparison of required analytical methods and detection limits with actual methods and detection limit for each analyte (K-H, 1998a). Table 2-4 presents the contract-required detection limits (CRDLs) for the various analytes.

Representativeness

The discussion of representativeness in this section is limited to an evaluation of whether analytical results for field samples are truly representative of environmental concentrations or whether they may have been influenced by the introduction of contamination during collection and handling. The potential introduction of contamination is evaluated by examination of the analytical results for equipment rinsates (Table 2-5). Equipment rinsates are used to assess the efficacy of the decontamination process and possible cross-contamination between environmental samples. They are samples of volatile free ASTM Type II water ("distilled" water) that have been poured over or through decontaminated sampling equipment and subsequently handled in the same manner as environmental samples.

Although rinsates are used specifically as indicators of cross-contamination during decontamination of equipment, they are carried through the entire sampling, shipping, and laboratory process and are, consequently, also good indicators of potential contamination introduced during any of these steps.

Table 2-2
Relative Percent Differences (RPDs) and Duplicate Error Ratios (DERs)
Groundwater 1998

Location	Sample Date	Analyte	Real Result	Real Result Qual	Real Valid	Dup Result	Dup Result Qual	Dup Valid	Units	Difference Real-Dup	Average (Real+Dup)/2	RPD Diff/Avg x100
Water Quality Parameters												
11891	3/5/98	Nitrate/Nitrite	5.9		V1	507			mg/L	501.10	256.45	**195.40**
12191	3/5/98	Nitrate/Nitrite	6.2		1	6		J1	mg/L	0.20	6.10	3.28
11891	3/5/98	Total Diss Solids	480		1	460			mg/L	20.00	470.00	4.26
12191	3/5/98	Total Diss Solids	540		1	580		V1	mg/L	40.00	560.00	7.14
12191	4/28/98	Nitrate/Nitrite	6.5			6.9			mg/L	0.40	6.70	5.97
12191	4/28/98	Total Diss Solids	790			770			mg/L	20.00	780.00	2.56
P209489	5/14/98	Fluoride	0.26			0.26			mg/L	0.00	0.26	0.00
P209489	5/14/98	Nitrate/Nitrite	120	N		120	N	1	mg/L	0.00	120.00	0.00
P209489	5/14/98	Sulfate	91			88			mg/L	3.00	89.50	3.35
P209489	5/14/98	Total Diss Solids	1400			1300			mg/L	100.00	1350.00	7.41
3586	6/5/98	Fluoride	0.41		V1	0.4			mg/L	0.01	0.41	2.47
3586	6/5/98	Nitrate/Nitrite	0.12		V1	0.12			mg/L	0.00	0.12	0.00
3586	6/5/98	Sulfate	180		V1	190			mg/L	10.00	185.00	5.41
3586	6/5/98	Total Diss Solids	990		J1	970			mg/L	20.00	980.00	2.04
11891	6/11/98	Nitrate/Nitrite	5.6		V1	5.7		V1	mg/L	0.10	5.65	1.77
11891	6/11/98	Total Diss Solids	510		V1	510		V1	mg/L	0.00	510.00	0.00
70193	7/14/98	Fluoride	0.23			0.17			mg/L	0.06	0.20	30.00
70193	7/14/98	Nitrate/Nitrite	1.9			1.9			mg/L	0.00	1.90	0.00
70193	7/14/98	Sulfate	25			20			mg/L	5.00	22.50	22.22
70193	7/14/98	Total Diss Solids	230			210			mg/L	20.00	220.00	9.09
03991	8/6/98	Nitrate/Nitrite	6.2			6.8			mg/L	0.60	6.50	9.23
03991	8/6/98	Total Diss Solids	550			560			mg/L	10.00	555.00	1.80
10498	8/12/98	Nitrate/Nitrite	25		V1	27			mg/L	2.00	26.00	7.69
05091	8/26/98	Nitrate/Nitrite	7.3			6.9			mg/L	0.40	7.10	5.63
05091	8/26/98	Total Diss Solids	600			570			mg/L	30.00	585.00	5.13
5887	8/31/98	Fluoride	0.17			0.17			mg/L	0.00	0.17	0.00
5887	8/31/98	Nitrate/Nitrite	2.2			2			mg/L	0.20	2.10	9.52
5887	8/31/98	Sulfate	24			24			mg/L	0.00	24.00	0.00
5887	8/31/98	Total Diss Solids	210			210			mg/L	0.00	210.00	0.00
3586	10/20/98	Total Diss Solids	1000		V1	1000			mg/L	0.00	1000.00	0.00
11891	11/19/98	Nitrate/Nitrite	6.3		V1	7.2		J1	mg/L	0.90	6.75	13.33
11891	11/19/98	Total Diss Solids	510		V1	560		V1	mg/L	50.00	535.00	9.35
70193	11/30/98	Fluoride	0.3		V1	0.31			mg/L	0.01	0.31	3.28
70193	11/30/98	Nitrate/Nitrite	2.1		V1	2.2			mg/L	0.10	2.15	4.65
70193	11/30/98	Sulfate	22		V1	22			mg/L	0.00	22.00	0.00
70193	11/30/98	Total Diss Solids	170		J1	170			mg/L	0.00	170.00	0.00
02291	12/4/98	Nitrate/Nitrite	6.4		V1	5.4			mg/L	1.00	5.90	16.95
02291	12/4/98	Total Diss Solids	420		V1	390			mg/L	30.00	405.00	7.41
5887	12/14/98	Fluoride	0.2		V1	0.2			mg/L	0.00	0.20	0.00
70393	12/14/98	Fluoride	0.16		V1	0.16			mg/L	0.00	0.16	0.00
5887	12/14/98	Nitrate/Nitrite	3.4		V1	3.4			mg/L	0.00	3.40	0.00
70393	12/14/98	Nitrate/Nitrite	5.8		V1	5.5			mg/L	0.30	5.65	5.31
5887	12/14/98	Sulfate	31		V1	30			mg/L	1.00	30.50	3.28
70393	12/14/98	Sulfate	28		V1	28			mg/L	0.00	28.00	0.00
5887	12/14/98	Total Diss Solids	160		V1	160			mg/L	0.00	160.00	0.00
70393	12/14/98	Total Diss Solids	160		V1	140			mg/L	20.00	150.00	13.33
12191	12/15/98	Nitrate/Nitrite	8.3		V1	7.4			mg/L	0.90	7.85	11.46
12191	12/15/98	Total Diss Solids	520		V1	570			mg/L	50.00	545.00	9.17

Note: RPD values greater than the 30% QC criterion are indicated in bold font.

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Table 2-2
Relative Percent Differences (RPDs) and Duplicate Error Ratios (DERs)
Groundwater 1998

Well	Sample Date	Analyte	Real Result	Real Result Qual	Real 2Sigma Error	Real Valid	Dup Result	Dup 2Sigma Error	Dup Valid	Units	Dup Result Qual	Difference Real-Dup	Square Root (2sigReal + 2sigDup)	DER Diff/SqrRt
Radionuclides														
02291	12/4/98	Uranium-233/234	2.13		0.635	V	3.03	0.884		pCi/L		0.90	1.09	0.83
0386	2/26/98	Americium-241	0.002		0.012		0.01	0.014		pCi/L		0.01	0.02	0.43
0386	2/26/98	Plutonium-239/240	-0.004		0.016		0.004	0.014		pCi/L		0.01	0.02	0.38
0386	2/26/98	Uranium-233/234	10.3		1.36		10.3	1.40		pCi/L		0.00	1.95	0.00
0386	2/26/98	Uranium-235	0.283		0.190		0.266	0.190		pCi/L		0.02	0.27	0.06
0386	2/26/98	Uranium-238	8.05		1.14		8.35	1.20		pCi/L		0.30	1.66	0.18
0386	8/25/98	Americium-241	0.003		0.015		0.005	0.006		pCi/L		0.00	0.02	0.12
0386	8/25/98	Plutonium-239/240	0.002		0.003		0	0.006		pCi/L		0.00	0.01	0.30
0386	8/25/98	Tritium	-137		190		-67.7	192		pCi/L		69.30	270.12	0.26
0386	8/25/98	Uranium-233/234	10.1		1.48		10.8	1.55		pCi/L		0.70	2.14	0.33
0386	8/25/98	Uranium-235	0.534		0.281		0.206	0.170		pCi/L		0.33	0.33	1.00
0386	8/25/98	Uranium-238	8.23		1.27		7.71	1.22		pCi/L		0.52	1.76	0.30
03991	8/6/98	Americium-241	0.009		0.016		0.003	0.016		pCi/L		0.01	0.02	0.27
03991	8/6/98	Plutonium-239/240	-0.001		0.010		0.001	0.006		pCi/L		0.00	0.01	0.17
03991	8/6/98	Uranium-233/234	2.09		0.521		2.06	0.515		pCi/L		0.03	0.73	0.04
03991	8/6/98	Uranium-235	-0.014		0.028		0.104	0.138		pCi/L		0.12	0.14	0.84
03991	8/6/98	Uranium-238	1.38		0.410		1.08	0.363		pCi/L		0.30	0.55	0.55
05091	2/27/98	Uranium-233/234	4.21		0.739		4.38	0.746		pCi/L		0.17	1.05	0.16
05091	2/27/98	Uranium-238	2.39		0.527		1.79	0.439	V	pCi/L		0.60	0.69	0.87
05091	8/26/98	Americium-241	0.012		0.018		0.008	0.016		pCi/L		0.00	0.02	0.17
05091	8/26/98	Plutonium-239/240	0.006		0.010		-0.001	0.008		pCi/L		0.01	0.01	0.55
05091	8/26/98	Uranium-233/234	5.06		0.981		4.14	0.830		pCi/L		0.92	1.29	0.72
05091	8/26/98	Uranium-235	0.103		0.142		0.147	0.148		pCi/L		0.04	0.21	0.21
05091	8/26/98	Uranium-238	3.06		0.714		2.32	0.580		pCi/L		0.74	0.92	0.80
10294	2/10/98	Plutonium-239/240	0.0075	J	0.00359		0.00244	0.00829		pCi/L		0.01	0.01	0.56
10294	2/10/98	Uranium-233/234	25.144		1.78		27.9	1.78		pCi/L		2.76	2.52	1.09
10294	2/10/98	Uranium-235	0.8554	J	0.328		0.865	0.317		pCi/L		0.01	0.46	0.02
10294	2/10/98	Uranium-238	17.9772		1.51		24	1.65		pCi/L		6.02	2.24	**2.69**
10294	7/29/98	Tritium	-47.3		118		-47.1	118		pCi/L		0.20	166.88	0.00
10294	7/29/98	Uranium-233/234	21.6128		2.133		18.5942	1.5712		pCi/L		3.02	2.65	1.14
10294	7/29/98	Uranium-235	1.1801		0.5039		0.6239	0.2874		pCi/L	J	0.56	0.58	0.96
10294	7/29/98	Uranium-238	16.2807		1.8501		16.5896	1.4841		pCi/L		0.31	2.37	0.13
11891	3/5/98	Americium-241	0.065		0.042		0.11	0.064		pCi/L	J	0.05	0.08	0.59
11891	3/5/98	Uranium-233/234	2.25		0.421		2.32	0.459		pCi/L		0.07	0.62	0.11
11891	3/5/98	Uranium-235	0.124	J	0.078		0.118	0.087		pCi/L	J	0.01	0.12	0.05
11891	3/5/98	Uranium-238	1.32		0.295		1.58	0.360		pCi/L		0.26	0.47	0.56
11891	6/11/98	Uranium-235	0.1208	J	0.0655		0.2723	0.145		pCi/L	J	0.15	0.16	0.95
11891	6/11/98	Uranium-238	1.4137		0.2249		1.15	0.2975	J	pCi/L		0.26	0.37	0.71
11891	11/19/98	Plutonium-239/240	0.036		0.019	V1	0.046	0.019	V1	pCi/L		0.01	0.03	0.37
12191	3/5/98	Uranium-233/234	2.36		0.456		2.09	0.415	V1	pCi/L		0.27	0.62	0.44
12191	3/5/98	Uranium-238	1.49		0.338		1.04	0.269	V1	pCi/L		0.45	0.43	1.04
12191	4/28/98	Uranium-233/234	1.6303		0.3391		1.8459	0.3412		pCi/L		0.22	0.48	0.45
12191	4/28/98	Uranium-238	1.2716		0.2981		1.2971	0.2902		pCi/L		0.03	0.42	0.06
12191	12/15/98	Uranium-233/234	2.1		0.679	V1	2.2	0.667		pCi/L		0.10	0.95	0.11
12191	12/15/98	Uranium-238	1.13		0.439	V1	1.08	0.403		pCi/L		0.05	0.60	0.08
3586	3/16/98	Uranium-233/234	3.01		0.650		2.28	0.570		pCi/L		0.73	0.86	0.84
3586	3/16/98	Uranium-238	1.91		0.491		2.73	0.637		pCi/L		0.82	0.80	1.02
3586	6/5/98	Americium-241	0.0108	J	0.0068		0.0101	0.0078		pCi/L	J	0.00	0.01	0.07
3586	6/5/98	Uranium-233/234	2.2001		0.2752		2.2748	0.2711		pCi/L		0.07	0.39	0.19
3586	6/5/98	Uranium-235	0.1072	J	0.0604		0.1299	0.066		pCi/L	J	0.02	0.09	0.25
3586	6/5/98	Uranium-238	1.6167		0.2357		1.5891	0.2259		pCi/L		0.03	0.33	0.08
3586	10/20/98	Uranium-233/234	2.44		0.741	V	2.28	0.687		pCi/L		0.16	1.01	0.16
3586	10/20/98	Uranium-238	2.02		0.643	V	1.77	0.570		pCi/L		0.25	0.86	0.29
41591	2/26/98	Americium-241	0.007		0.012		0.018	0.015		pCi/L		0.01	0.02	0.57
41591	2/26/98	Plutonium-239/240	0.014		0.016		0.008	0.011		pCi/L		0.01	0.02	0.31
41591	2/26/98	Uranium-233/234	10.5		1.38		10.9	1.40		pCi/L		0.40	1.97	0.20
41591	2/26/98	Uranium-235	0.316		0.202		0.347	0.211		pCi/L		0.03	0.29	0.11
41591	2/26/98	Uranium-238	8.2		1.16		7.56	1.09		pCi/L		0.64	1.59	0.40
41591	8/27/98	Americium-241	0.015		0.016		0.004	0.020		pCi/L		0.01	0.03	0.43
41591	8/27/98	Plutonium-239/240	0		0.009		-0.001	0.007		pCi/L		0.00	0.01	0.09
41591	8/27/98	Tritium	-328		180		-130	180		pCi/L		198.00	254.56	0.78
41591	8/27/98	Uranium-233/234	9.05		1.37		9.61	1.56		pCi/L		0.56	2.08	0.27
41591	8/27/98	Uranium-235	0.602		0.307		0.19	0.190		pCi/L		0.41	0.36	1.14
41591	8/27/98	Uranium-238	8.32		1.29		9.17	1.51		pCi/L		0.85	1.99	0.43
5887	8/31/98	Tritium	-324		174		-266	160		pCi/L		58.00	236.38	0.25
5887	12/14/98	Uranium-233/234	0.071	J	0.083	V1	0.073	0.086		pCi/L	J	0.00	0.12	0.02
70193	2/26/98	Uranium-233/234	0.025		0.049		0.206	0.147		pCi/L		0.18	0.15	1.17
70193	2/26/98	Uranium-235	0.018		0.066		0	0.000		pCi/L		0.02	0.07	0.27
70193	2/26/98	Uranium-238	0.367		0.192		0.434	0.214		pCi/L		0.07	0.29	0.23

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Table 2-2
Relative Percent Differences (RPDs) and Duplicate Error Ratios (DERs)
Groundwater 1998

Well	Sample Date	Analyte	Real Result	Real Result Qual	Real 2Sigma Error	Real Valid	Dup Result	Dup 2Sigma Error	Dup Valid	Units	Dup Result Qual	Difference Real-Dup	Square Root (2sigReal + 2sigDup)	DER Diff/SqrRt
Radionuclides														
70193	7/14/98	Tritium	-16		121		-112	118		pCi/L		96.00	169.01	0.57
70193	11/30/98	Uranium-238	0.238	J	0.166	V	0.248	0.174		pCi/L	J	0.01	0.24	0.04
70393	8/26/98	Tritium	-200		184		-97.6	183		pCi/L		102.40	259.51	0.39
70393	8/26/98	Uranium-233/234	0.095		0.109		0.145	0.130		pCi/L		0.05	0.17	0.29
70393	8/26/98	Uranium-235	0.005		0.076		0.032	0.064		pCi/L		0.03	0.10	0.27
70393	8/26/98	Uranium-238	0.265		0.170		0.067	0.092		pCi/L		0.20	0.19	1.02
891COLGAL	8/20/98	Uranium-233/234	5.96		1.06		6.25	1.09		pCi/L		0.29	1.52	0.19
891COLGAL	8/20/98	Uranium-235	0.302		0.216		0.112	0.130		pCi/L		0.19	0.25	0.75
891COLGAL	8/20/98	Uranium-238	5.17		0.969		3.96	0.809		pCi/L		1.21	1.26	0.96
891COLWEL	8/20/98	Uranium-233/234	11.7		1.64		11.7	1.68		pCi/L		0.00	2.35	0.00
891COLWEL	8/20/98	Uranium-235	0.334		0.214		0.301	0.215		pCi/L		0.03	0.30	0.11
891COLWEL	8/20/98	Uranium-238	8.59		1.30		7.66	1.23		pCi/L		0.93	1.79	0.52
P209489	5/14/98	Tritium	265.96	J	138		382.134	143		pCi/L	J	116.17	198.73	0.58
P209489	5/14/98	Uranium-233/234	13.3387		0.966		13.3111	1.00		pCi/L		0.03	1.39	0.02
P209489	5/14/98	Uranium-235	0.657	J	0.214		1.1792	0.300		pCi/L		0.52	0.37	1.42
P209489	5/14/98	Uranium-238	10.6819		0.864		12.3758	0.965		pCi/L		1.69	1.30	1.31
SW13494	11/2/98	Uranium-233/234	3.15		0.889	V1	4.71	0.886		pCi/L		1.56	1.26	1.24
SW13494	11/2/98	Uranium-235	0.154	J	0.145	V1	0.342	0.230		pCi/L		0.19	0.27	0.69
SW13494	11/2/98	Uranium-238	2.28		0.692	V1	3.88	0.782		pCi/L		1.60	1.04	1.53

Note: DER values greater than the 1.96 QC criterion are indicated in bold font.

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Table 2-2
Relative Percent Differences (RPDs) and Duplicate Error Ratios (DERs)
Groundwater 1998

Location	Sample Date	Analyte	Real Result	Real Result Qual	Real Valid	Dup Result	Dup Result Qual	Dup Valid	Units	Difference Real-Dup	Average (Real+Dup)/2	RPD Diff/Avg x100
Volatile Organic Compounds												
02291	12/4/98	1,1,1-Trichloroethane	3		V	4			ug/L	1.00	3.50	28.57
02291	12/4/98	1,1-Dichloroethane	2		V	2			ug/L	0.00	2.00	0.00
02291	12/4/98	1,1-Dichloroethene	6		J	6			ug/L	0.00	6.00	0.00
02291	12/4/98	Chloroform	3		V	3		UJ	ug/L	0.00	3.00	0.00
02291	12/4/98	cis-1,2-Dichloroethene	17		V	20		V	ug/L	3.00	18.50	16.22
02291	12/4/98	Methylene Chloride	0.9	BJ	JB	0.8	BJ		ug/L	0.10	0.85	11.76
02291	12/4/98	Tetrachloroethene	3400	D	V	5700	D	J1	ug/L	2300.00	4550.00	**50.55**
02291	12/4/98	Trichloroethene	450	D	V	620	D	V1	ug/L	170.00	535.00	**31.78**
03991	8/6/98	Carbon Tetrachloride	40	D		41	D	V1	ug/L	1.00	40.50	2.47
03991	8/6/98	Chloroform	2	D		2		UJ1	ug/L	0.00	2.00	0.00
03991	8/6/98	Tetrachloroethene	11			11			ug/L	0.00	11.00	0.00
03991	8/6/98	Trichloroethene	6			6			ug/L	0.00	6.00	0.00
05091	8/26/98	Carbon Tetrachloride	0.8	J		0.7	J		ug/L	0.10	0.75	13.33
05091	8/26/98	Chromium	2.4			2.3		V1	ug/L	0.10	2.35	4.26
05091	8/26/98	Tetrachloroethene	3			3		V	ug/L	0.00	3.00	0.00
10498	8/12/98	Tetrachloroethene	9			15			ug/L	6.00	12.00	**50.00**
10498	8/19/98	Methylene Chloride	0.6	J	J1	0.6	J		ug/L	0.00	0.60	0.00
10498	8/19/98	Tetrachloroethene	5			4			ug/L	1.00	4.50	22.22
11891	3/5/98	1,1,1-Trichloroethane	3			3			ug/L	0.00	3.00	0.00
11891	3/5/98	1,1-Dichloroethene	3			4			ug/L	1.00	3.50	28.57
11891	3/5/98	Carbon Tetrachloride	460			460	D		ug/L	0.00	460.00	0.00
11891	3/5/98	Chloroform	13			14			ug/L	1.00	13.50	7.41
11891	3/5/98	cis-1,2-Dichloroethene	15			16			ug/L	1.00	15.50	6.45
11891	3/5/98	Tetrachloroethene	250			260	D		ug/L	10.00	255.00	3.92
11891	3/5/98	Trichloroethene	54			60	D		ug/L	6.00	57.00	10.53
11891	6/11/98	1,1,1-Trichloroethane	1			1			ug/L	0.00	1.00	0.00
11891	6/11/98	1,1-Dichloroethene	2			2		J	ug/L	0.00	2.00	0.00
11891	6/11/98	Carbon Tetrachloride	180	D		160	D	V1	ug/L	20.00	170.00	11.76
11891	6/11/98	Chloroform	8			9		J	ug/L	1.00	8.50	11.76
11891	6/11/98	cis-1,2-Dichloroethene	9	JD		9		1	ug/L	0.00	9.00	0.00
11891	6/11/98	Tetrachloroethene	92	D		86	D	V1	ug/L	6.00	89.00	6.74
11891	6/11/98	Trichloroethene	24			26		J	ug/L	2.00	25.00	8.00
11891	11/19/98	1,1,1-Trichloroethane	0.7	J	J1	2			ug/L	1.30	1.35	**96.30**
11891	11/19/98	1,1-Dichloroethene	1		J1	3		V1	ug/L	2.00	2.00	**100.00**
11891	11/19/98	Carbon Tetrachloride	430	D	V1	430	D	J1	ug/L	0.00	430.00	0.00
11891	11/19/98	Chloroform	5		J1	15		V1	ug/L	10.00	10.00	**100.00**
11891	11/19/98	cis-1,2-Dichloroethene	20	DJ	J1	21	DJ	V1	ug/L	1.00	20.50	4.88
11891	11/19/98	Tetrachloroethene	500	D	V1	210	D	V1	ug/L	290.00	355.00	**81.69**
11891	11/19/98	Trichloroethene	80	D	J1	46	D	J1	ug/L	34.00	63.00	**53.97**
12191	3/5/98	1,1,1-Trichloroethane	2			3		J1	ug/L	1.00	2.50	**40.00**
12191	3/5/98	1,1-Dichloroethene	2			3		V1	ug/L	1.00	2.50	**40.00**
12191	3/5/98	Carbon Tetrachloride	240			220	D		ug/L	20.00	230.00	8.70
12191	3/5/98	Chloroform	5			6		V1	ug/L	1.00	5.50	18.18
12191	3/5/98	cis-1,2-Dichloroethene	10			10		V1	ug/L	0.00	10.00	0.00
12191	3/5/98	Tetrachloroethene	290			280	D		ug/L	10.00	285.00	3.51
12191	3/5/98	Trichloroethene	53			46	D		ug/L	7.00	49.50	14.14
12191	4/28/98	1,1,1-Trichloroethane	6			5		UJ1	ug/L	1.00	5.50	18.18
12191	4/28/98	1,1-Dichloroethene	7			6		V1	ug/L	1.00	6.50	15.38
12191	4/28/98	Carbon Tetrachloride	220			220		V1	ug/L	0.00	220.00	0.00
12191	4/28/98	Chloroform	11			10		V1	ug/L	1.00	10.50	9.52
12191	4/28/98	cis-1,2-Dichloroethene	9			8		V1	ug/L	1.00	8.50	11.76
12191	4/28/98	Tetrachloroethene	210			190		V1	ug/L	20.00	200.00	10.00
12191	4/28/98	Trichloroethene	27			24		V1	ug/L	3.00	25.50	11.76
12191	12/15/98	Carbon Tetrachloride	140		J	140			ug/L	0.00	140.00	0.00
12191	12/15/98	Chloroform	5		J	5			ug/L	0.00	5.00	0.00
12191	12/15/98	cis-1,2-Dichloroethene	8		J	6			ug/L	2.00	7.00	28.57
12191	12/15/98	Methylene Chloride	3	B	UJ	3	B		ug/L	0.00	3.00	0.00
12191	12/15/98	Tetrachloroethene	170		J	170			ug/L	0.00	170.00	0.00
12191	12/15/98	Trichloroethene	25		J	24			ug/L	1.00	24.50	4.08
3586	6/5/98	1,1,1-Trichloroethane	1			1			ug/L	0.00	1.00	0.00
3586	6/5/98	1,1-Dichloroethane	19			19			ug/L	0.00	19.00	0.00
3586	6/5/98	cis-1,2-Dichloroethene	9			8			ug/L	1.00	8.50	11.76
3586	6/5/98	trans-1,2-Dichloroethene	0.6	J		0.5	J	UJ1	ug/L	0.10	0.55	18.18
3586	6/5/98	Trichloroethene	1			1			ug/L	0.00	1.00	0.00
3586	6/5/98	Vinyl Chloride	14			14			ug/L	0.00	14.00	0.00
3586	10/20/98	1,1,1-Trichloroethane	1		V1	1			ug/L	0.00	1.00	0.00
3586	10/20/98	1,1-Dichloroethane	39		V1	40			ug/L	1.00	39.50	2.53
3586	10/20/98	Benzene	0.8	J	J1	0.9	J		ug/L	0.10	0.85	11.76
3586	10/20/98	cis-1,2-Dichloroethene	10		V1	12			ug/L	2.00	11.00	18.18
3586	10/20/98	Methylene Chloride	0.7	BJ	JB1	0.8	BJ		ug/L	0.10	0.75	13.33
3586	10/20/98	trans-1,2-Dichloroethene	0.8	J	V1	0.8	J		ug/L	0.00	0.80	0.00
3586	10/20/98	Trichloroethene	0.7	J	V1	0.8	J		ug/L	0.10	0.75	13.33
3586	10/20/98	Vinyl Chloride	34		V1	39			ug/L	5.00	36.50	13.70
5887	8/31/98	Chromium	2			2			ug/L	0.00	2.00	0.00

Table 2-2
Relative Percent Differences (RPDs) and Duplicate Error Ratios (DERs)
Groundwater 1998

Location	Sample Date	Analyte	Real Result	Real Result Qual	Real Valid	Dup Result	Dup Result Qual	Dup Valid	Units	Difference Real-Dup	Average (Real+Dup)/2	RPD Diff/Avg x100
Volatile Organic Compounds												
70193	7/14/98	1,1,1-Trichloroethane	0.2	J		0.2	J	R1	ug/L	0.00	0.20	0.00
70193	7/14/98	Methylene Chloride	2	J		1	J		ug/L	1.00	1.50	**66.67**
70193	9/29/98	Methylene Chloride	4			4			ug/L	0.00	4.00	0.00
70393	12/14/98	1,1,1-Trichloroethane	28		J	30			ug/L	2.00	29.00	6.90
70393	12/14/98	1,1-Dichloroethene	14		J	16			ug/L	2.00	15.00	13.33
70393	12/14/98	Carbon Tetrachloride	0.7	J	J	0.8	J	J1	ug/L	0.10	0.75	13.33
70393	12/14/98	Tetrachloroethene	7		J	7			ug/L	0.00	7.00	0.00
70393	12/14/98	Trichloroethene	21		J	22			ug/L	1.00	21.50	4.65
891COLGAL	8/20/98	Methylene Chloride	0.7	J		0.8	J		ug/L	0.10	0.75	13.33
891COLGAL	8/20/98	Trichloroethene	0.7	J		1			ug/L	0.30	0.85	**35.29**
891COLWEL	8/20/98	1,1,1-Trichloroethane	0.6	J		0.7	J		ug/L	0.10	0.65	15.38
891COLWEL	8/20/98	1,1-Dichloroethene	3			3			ug/L	0.00	3.00	0.00
891COLWEL	8/20/98	Carbon Tetrachloride	12			12			ug/L	0.00	12.00	0.00
891COLWEL	8/20/98	Chloroform	0.8	J		0.9	J		ug/L	0.10	0.85	11.76
891COLWEL	8/20/98	Methylene Chloride	0.8	J		0.8	J		ug/L	0.00	0.80	0.00
891COLWEL	8/20/98	Tetrachloroethene	13			13			ug/L	0.00	13.00	0.00
891COLWEL	8/20/98	Trichloroethene	100	D		100	D	V1	ug/L	0.00	100.00	0.00
P209489	5/14/98	1,1-Dichloroethene	0.6	J		1	D		ug/L	0.40	0.80	**50.00**
P209489	5/14/98	Carbon Tetrachloride	52	D		44	D	UJ1	ug/L	8.00	48.00	16.67
P209489	5/14/98	Chloroform	20	D		17	D	V1	ug/L	3.00	18.50	16.22
P209489	5/14/98	cis-1,2-Dichloroethene	10	D		10		V1	ug/L	0.00	10.00	0.00
P209489	5/14/98	Methylene Chloride	6	B		6	D		ug/L	0.00	6.00	0.00
P209489	5/14/98	Tetrachloroethene	3	D		3		V1	ug/L	0.00	3.00	0.00
P209489	5/14/98	Trichloroethene	63	D		55	D	V1	ug/L	8.00	59.00	13.56
SW13494	11/2/98	cis-1,2-Dichloroethene	2		V1	0.9	J		ug/L	1.10	1.45	**75.86**
SW13494	11/2/98	Methylene Chloride	5	B	UJ1	2			ug/L	3.00	3.50	**85.71**
SW13494	11/2/98	Tetrachloroethene	40		V1	18			ug/L	22.00	29.00	**75.86**
SW13494	11/2/98	Trichloroethene	3		V1	1			ug/L	2.00	2.00	**100.00**

Note: RPD values greater than the 30% QC criterion are indicated in bold font.

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Table 2-2
Relative Percent Differences (RPDs) and Duplicate Error Ratios (DERs)
Groundwater 1998

Location	Sample Date	Analyte	Real Result	Real Result Qual	Real Valid	Dup Result	Dup Result Qual	Dup Valid	Units	Difference Real-Dup	Average (Real+Dup)/2	RPD Diff./Avg x100
Metals												
02291	12/4/98	Barium	172	E		194	E	J	ug/L	22.00	183.00	12.02
02291	12/4/98	Calcium	65700	E		73900	E	J	ug/L	8200.00	69800.00	11.75
02291	12/4/98	Magnesium	19100	E		21400	E	J	ug/L	2300.00	20250.00	11.36
02291	12/4/98	Sodium	16200	E		17900	E	UJ	ug/L	1700.00	17050.00	9.97
02291	12/4/98	Strontium	563	E		637	E	J	ug/L	74.00	600.00	12.33
02291	12/4/98	Thallium	1.1	N		1.5	N	1	ug/L	0.40	1.30	**30.77**
03991	8/6/98	Barium	239			234			ug/L	5.00	236.50	2.11
03991	8/6/98	Calcium	124000	E		122000	E	J	ug/L	2000.00	123000.00	1.63
03991	8/6/98	Magnesium	13900			13500			ug/L	400.00	13700.00	2.92
03991	8/6/98	Sodium	16200	E		16000	E	UJ1	ug/L	200.00	16100.00	1.24
03991	8/6/98	Strontium	498			487			ug/L	11.00	492.50	2.23
05091	8/26/98	Barium	168			167		V	ug/L	1.00	167.50	0.60
05091	8/26/98	Calcium	100000			101000		V1	ug/L	1000.00	100500.00	1.00
05091	8/26/98	Magnesium	16300			16700		V1	ug/L	400.00	16500.00	2.42
05091	8/26/98	Sodium	31300			30300		J1	ug/L	1000.00	30800.00	3.25
05091	8/26/98	Strontium	588			587			ug/L	1.00	587.50	0.17
10498	8/12/98	Aluminum	50.8	E	J1	43.3	E	V1	ug/L	7.50	47.05	15.94
10498	8/12/98	Calcium	32000			34300			ug/L	2300.00	33150.00	6.94
10498	8/12/98	Chromium	2.9	N	J1	2.9	N	1	ug/L	0.00	2.90	0.00
10498	8/12/98	Copper	4.8			5			ug/L	0.20	4.90	4.08
10498	8/12/98	Lead	1.8			1.9			ug/L	0.10	1.85	5.41
10498	8/12/98	Manganese	52			45.9			ug/L	6.10	48.95	12.46
10498	8/12/98	Selenium	2.7	N	J1	2.7	N	1	ug/L	0.00	2.70	0.00
10498	8/12/98	Sodium	146000			136000			ug/L	10000.00	141000.00	7.09
10498	8/12/98	Zinc	29.4		UJ1	56.4			ug/L	27.00	42.90	**62.94**
11891	3/5/98	Barium	224		V1	221			ug/L	3.00	222.50	1.35
11891	3/5/98	Calcium	121000		V1	120000			ug/L	1000.00	120500.00	0.83
11891	3/5/98	Magnesium	11400		V1	11300			ug/L	100.00	11350.00	0.88
11891	3/5/98	Sodium	18800		V1	18800			ug/L	0.00	18800.00	0.00
11891	3/5/98	Strontium	422		V1	418			ug/L	4.00	420.00	0.95
11891	6/11/98	Barium	224			210		J	ug/L	14.00	217.00	6.45
11891	6/11/98	Calcium	117000			110000		UJ1	ug/L	7000.00	113500.00	6.17
11891	6/11/98	Magnesium	11800			10900		V1	ug/L	900.00	11350.00	7.93
11891	6/11/98	Selenium	2.4	N*		1.4	N*	1	ug/L	1.00	1.90	**52.63**
11891	6/11/98	Sodium	31200	E		29500	E	V1	ug/L	1700.00	30350.00	5.60
11891	6/11/98	Strontium	407	N		381	N	1	ug/L	26.00	394.00	6.60
11891	11/19/98	Barium	220		V1	213		V1	ug/L	7.00	216.50	3.23
11891	11/19/98	Calcium	111000		V1	108000		V1	ug/L	3000.00	109500.00	2.74
11891	11/19/98	Magnesium	11100		V1	10700		V1	ug/L	400.00	10900.00	3.67
11891	11/19/98	Sodium	18000		V1	17700		V1	ug/L	300.00	17850.00	1.68
11891	11/19/98	Strontium	404		V1	392		UJ1	ug/L	12.00	398.00	3.02
12191	3/5/98	Calcium	134000		1	135000		V1	ug/L	1000.00	134500.00	0.74
12191	3/5/98	Magnesium	10700		1	10700		J1	ug/L	0.00	10700.00	0.00
12191	3/5/98	Sodium	12300		1	12400		V1	ug/L	100.00	12350.00	0.81
12191	3/5/98	Strontium	431		1	433		UJ1	ug/L	2.00	432.00	0.46
12191	4/28/98	Barium	165			157		V1	ug/L	8.00	161.00	4.97
12191	4/28/98	Calcium	133000			125000		V1	ug/L	8000.00	129000.00	6.20
12191	4/28/98	Magnesium	10300			9720			ug/L	580.00	10010.00	5.79
12191	4/28/98	Sodium	12700			12100			ug/L	600.00	12400.00	4.84
12191	4/28/98	Strontium	399			380			ug/L	19.00	389.50	4.88
12191	12/15/98	Barium	181		V1	194			ug/L	13.00	187.50	6.93
12191	12/15/98	Calcium	121000		V1	129000			ug/L	8000.00	125000.00	6.40
12191	12/15/98	Strontium	390		V1	419			ug/L	29.00	404.50	7.17
3586	6/5/98	Aluminum	20.8	*		40.1	*		ug/L	19.30	30.45	**63.38**
3586	6/5/98	Arsenic	2.8			2.7			ug/L	0.10	2.75	3.64
3586	6/5/98	Calcium	131000			129000			ug/L	2000.00	130000.00	1.54
3586	6/5/98	Iron	2380			2370			ug/L	10.00	2375.00	0.42
3586	6/5/98	Magnesium	34500			34200			ug/L	300.00	34350.00	0.87
3586	6/5/98	Manganese	4180			4110			ug/L	70.00	4145.00	1.69
3586	6/5/98	Sodium	162000	E		157000	E	V1	ug/L	5000.00	159500.00	3.13
3586	6/5/98	Strontium	828	N		814	N	1	ug/L	14.00	821.00	1.71
3586	10/20/98	Arsenic	2.4		V	2.6			ug/L	0.20	2.50	8.00
3586	10/20/98	Calcium	134000		J	129000			ug/L	5000.00	131500.00	3.80

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Table 2-2
Relative Percent Differences (RPDs) and Duplicate Error Ratios (DERs)
Groundwater 1998

Location	Sample Date	Analyte	Real Result	Real Result Qual	Real Valid	Dup Result	Dup Result Qual	Dup Valid	Units	Difference Real-Dup	Average (Real+Dup)/2	RPD Diff./Avg x100
						Metals						
3586	10/20/98	Iron	2310		J	2190			ug/L	120.00	2250.00	5.33
3586	10/20/98	Magnesium	37500		J	35600			ug/L	1900.00	36550.00	5.20
3586	10/20/98	Manganese	4270		J	4060			ug/L	210.00	4165.00	5.04
3586	10/20/98	Sodium	163000		J	156000			ug/L	7000.00	159500.00	4.39
3586	10/20/98	Strontium	932		J	886			ug/L	46.00	909.00	5.06
5887	5/26/98	Calcium	18300			17500			ug/L	800.00	17900.00	4.47
5887	5/26/98	Copper	3.6			3.3			ug/L	0.30	3.45	8.70
5887	5/26/98	Selenium	1.7			1.3			ug/L	0.40	1.50	26.67
5887	5/26/98	Sodium	6040	E		5870	E	V1	ug/L	170.00	5955.00	2.85
5887	8/31/98	Calcium	20300			20200			ug/L	100.00	20250.00	0.49
5887	8/31/98	Sodium	7190			6890			ug/L	300.00	7040.00	4.26
5887	12/14/98	Aluminum	20.4		UJ1	18			ug/L	2.40	19.20	12.50
5887	12/14/98	Calcium	20400		V1	19500			ug/L	900.00	19950.00	4.51
5887	12/14/98	Chromium	3.1		V1	3.2			ug/L	0.10	3.15	3.17
5887	12/14/98	Copper	4.6		V1	4.5			ug/L	0.10	4.55	2.20
70193	7/14/98	Aluminum	35.2			28.2			ug/L	7.00	31.70	22.08
70193	7/14/98	Calcium	23300			25600			ug/L	2300.00	24450.00	9.41
70193	7/14/98	Selenium	3.9			4.9			ug/L	1.00	4.40	22.73
70193	7/14/98	Sodium	13400			13500			ug/L	100.00	13450.00	0.74
70193	11/30/98	Aluminum	41.5	*		49.7	*		ug/L	8.20	45.60	17.98
70193	11/30/98	Calcium	20700	E		19700	E	V1	ug/L	1000.00	20200.00	4.95
70193	11/30/98	Sodium	10800	E		10700	E	V1	ug/L	100.00	10750.00	0.93
70193	11/30/98	Strontium	240	E		138	E	V1	ug/L	102.00	189.00	**53.97**
70393	8/26/98	Aluminum	19.1			19.2			ug/L	0.10	19.15	0.52
70393	8/26/98	Calcium	20300			20800			ug/L	500.00	20550.00	2.43
70393	8/26/98	Sodium	13200			12900			ug/L	300.00	13050.00	2.30
70393	12/14/98	Calcium	18000		V1	16800			ug/L	1200.00	17400.00	6.90
891COLGAL	8/20/98	Arsenic	1.7			1.8			ug/L	0.10	1.75	5.71
891COLGAL	8/20/98	Barium	73.7			140		J1	ug/L	66.30	106.85	**62.05**
891COLGAL	8/20/98	Calcium	61800			114000			ug/L	52200.00	87900.00	**59.39**
891COLGAL	8/20/98	Selenium	15	N		14.3	N	1	ug/L	0.70	14.65	4.78
891COLGAL	8/20/98	Strontium	523			996			ug/L	473.00	759.50	**62.28**
891COLGAL	8/20/98	Zinc	115			121			ug/L	6.00	118.00	5.08
891COLWEL	8/20/98	Barium	68.5			69.7			ug/L	1.20	69.10	1.74
891COLWEL	8/20/98	Calcium	167000			170000			ug/L	3000.00	168500.00	1.78
891COLWEL	8/20/98	Magnesium	37200			37900			ug/L	700.00	37550.00	1.86
891COLWEL	8/20/98	Nickel	24.1			24			ug/L	0.10	24.05	0.42
891COLWEL	8/20/98	Selenium	470	N		457	N	1	ug/L	13.00	463.50	2.80
891COLWEL	8/20/98	Sodium	143000			141000			ug/L	2000.00	142000.00	1.41
891COLWEL	8/20/98	Strontium	1280			1310			ug/L	30.00	1295.00	2.32
P209489	5/14/98	Antimony	2	N*		1.3	N*	1	ug/L	0.70	1.65	**42.42**
P209489	5/14/98	Cadmium	0.36	N		0.3	N	1	ug/L	0.06	0.33	18.18
P209489	5/14/98	Calcium	136000			135000			ug/L	1000.00	135500.00	0.74
P209489	5/14/98	Magnesium	23500			23200			ug/L	300.00	23350.00	1.28
P209489	5/14/98	Sodium	229000			232000			ug/L	3000.00	230500.00	1.30
P209489	5/14/98	Strontium	644			638			ug/L	6.00	641.00	0.94
SW13494	11/2/98	Barium	140	E		162		V1	ug/L	22.00	151.00	14.57
SW13494	11/2/98	Calcium	80300	E		95000		UJ1	ug/L	14700.00	87650.00	16.77
SW13494	11/2/98	Sodium	42500	E		50400		V1	ug/L	7900.00	46450.00	17.01
SW13494	11/2/98	Strontium	602	E		723		J1	ug/L	121.00	662.50	18.26
SW13494	11/2/98	Zinc	57.5			50.9			ug/L	6.60	54.20	12.18

Note: RPD values greater than the 30% QC criterion are indicated in bold font.

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Table 2-3
Summary of RPD and DER Results
Groundwater 1998

Analytical Suite	QC Criterion for RPD or DER Value	Number of RPD/DER Pairs Calculated	Number of Duplicates Within RPD or DER Criterion	Overall Precision Compliance
Metals	less than 30%	114	105	92.1%
Volatile Organic Compounds	less than 30%	102	85	83.3%
Radionuclides	less than 1.96	88	87	98.9%
Water Quality Parameters	less than 30%	48	47	97.9%

Note: Calculations not made for results qualified as undetected for any analyte. This includes "R" validated data, "U" qualified VOC, data, and "U" and "B" qualified inorganic data.

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Table 2-4
Comparison of Analytical Methods and Detection Limits
Groundwater 1998

CAS#	Analyte	Required Analytical Method	Actual Analytical Method	Required CRDL	Percent at or Below Required CRDL	Units
Volatile Organic Compounds						
630-20-6	1,1,1,2-Tetrachloroethane	EPA 524.2	EPA 524.2	1	98%	ug/L
71-55-6	1,1,1-Trichloroethane	EPA 524.2	EPA 524.2	1	99%	ug/L
79-34-5	1,1,2,2-Tetrachloroethane	EPA 524.2	EPA 524.2	1	100%	ug/L
79-00-5	1,1,2-Trichloroethane	EPA 524.2	EPA 524.2	1	100%	ug/L
75-34-3	1,1-Dichloroethane	EPA 524.2	EPA 524.2	1	99%	ug/L
75-35-4	1,1-Dichloroethene	EPA 524.2	EPA 524.2	1	100%	ug/L
563-58-6	1,1-Dichloropropene	EPA 524.2	EPA 524.2	1	98%	ug/L
87-61-6	1,2,3-Trichlorobenzene	EPA 524.2	EPA 524.2	1	98%	ug/L
96-18-4	1,2,3-Trichloropropane	EPA 524.2	EPA 524.2	1	98%	ug/L
120-82-1	1,2,4-Trichlorobenzene	EPA 524.2	EPA 524.2	1	99%	ug/L
95-63-6	1,2,4-Trimethylbenzene	EPA 524.2	EPA 524.2	1	98%	ug/L
96-12-8	1,2-Dibromo-3-chloropropane	EPA 524.2	EPA 524.2	1	100%	ug/L
106-93-4	1,2-Dibromoethane	EPA 524.2	EPA 524.2	1	98%	ug/L
95-50-1	1,2-Dichlorobenzene	EPA 524.2	EPA 524.2	1	99%	ug/L
107-06-2	1,2-Dichloroethane	EPA 524.2	EPA 524.2	1	100%	ug/L
78-87-5	1,2-Dichloropropane	EPA 524.3	EPA 524.2	1	100%	ug/L
95-47-6	1,2-Xylene	EPA 524.4	EPA 524.2	1	96%	ug/L
000-00-0	1,3- and 1,4-Xylene	EPA 524.5	EPA 524.2	1	96%	ug/L
108-67-8	1,3,5-Trimethylbenzene	EPA 524.2	EPA 524.2	1	98%	ug/L
541-73-1	1,3-Dichlorobenzene	EPA 524.2	EPA 524.2	1	99%	ug/L
142-28-9	1,3-Dichloropropane	EPA 524.2	EPA 524.2	1	98%	ug/L
106-46-7	1,4-Dichlorobenzene	EPA 524.2	EPA 524.2	1	99%	ug/L
594-20-7	2,2-Dichloropropane	EPA 524.2	EPA 524.2	1	98%	ug/L
95-49-8	2-Chlorotoluene	EPA 524.2	EPA 524.2	1	98%	ug/L
106-43-4	4-Chlorotoluene	EPA 524.2	EPA 524.2	1	98%	ug/L
99-87-6	4-Isopropyltoluene	EPA 524.2	EPA 524.2	1	98%	ug/L
71-43-2	Benzene	EPA 524.2	EPA 524.2	1	100%	ug/L
108-86-1	Bromobenzene	EPA 524.2	EPA 524.2	1	98%	ug/L
74-97-5	Bromochloromethane	EPA 524.2	EPA 524.2	1	98%	ug/L
75-27-4	Bromodichloromethane	EPA 524.2	EPA 524.2	1	99%	ug/L
75-25-2	Bromoform	EPA 524.2	EPA 524.2	1	99%	ug/L
74-83-9	Bromomethane	EPA 524.2	EPA 524.2	1	100%	ug/L
56-23-5	Carbon Tetrachloride	EPA 524.2	EPA 524.2	1	99%	ug/L
108-90-7	Chlorobenzene	EPA 524.2	EPA 524.2	1	99%	ug/L
75-00-3	Chloroethane	EPA 524.2	EPA 524.2	1	98%	ug/L
67-66-3	Chloroform	EPA 524.2	EPA 524.2	1	98%	ug/L
74-87-3	Chloromethane	EPA 524.2	EPA 524.2	1	100%	ug/L
156-59-2	cis-1,2-Dichloroethene	EPA 524.2	EPA 524.2	1	98%	ug/L
10061-01-5	cis-1,3-Dichloropropene	EPA 524.2	EPA 524.2	1	100%	ug/L
124-48-1	Dibromochloromethane	EPA 524.2	EPA 524.2	1	100%	ug/L
74-95-3	Dibromomethane	EPA 524.2	EPA 524.2	1	98%	ug/L
75-71-8	Dichlorodifluoromethane	EPA 524.2	EPA 524.2	1	98%	ug/L
100-41-4	Ethylbenzene	EPA 524.2	EPA 524.2	1	99%	ug/L
87-68-3	Hexachlorobutadiene	EPA 524.2	EPA 524.2	1	100%	ug/L
98-82-8	Isopropylbenzene	EPA 524.2	EPA 524.2	1	98%	ug/L
75-09-2	Methylene Chloride	EPA 524.2	EPA 524.2	1	99%	ug/L
91-20-3	Naphthalene	EPA 524.2	EPA 524.2	1	99%	ug/L
104-51-8	n-Butylbenzene	EPA 524.2	EPA 524.2	1	98%	ug/L
103-65-1	n-Propylbenzene	EPA 524.2	EPA 524.2	1	98%	ug/L
135-98-8	sec-Butylbenzene	EPA 524.2	EPA 524.2	1	98%	ug/L
100-42-5	Styrene	EPA 524.2	EPA 524.2	1	99%	ug/L
98-06-6	tert-Butylbenzene	EPA 524.2	EPA 524.2	1	98%	ug/L
127-18-4	Tetrachloroethene	EPA 524.2	EPA 524.2	1	99%	ug/L
108-88-3	Toluene	EPA 524.2	EPA 524.2	1	99%	ug/L
1330-20-7	Total Xylenes	EPA 524.2	EPA 524.2	1	100%	ug/L

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Table 2-4
Comparison of Analytical Methods and Detection Limits
Groundwater 1998

CAS#	Analyte	Required Analytical Method	Actual Analytical Method	Required CRDL	Percent at or Below Required CRDL	Units
156-60-5	trans-1,2-Dichloroethene	EPA 524.2	EPA 524.2	1	99%	ug/L
10061-02-6	trans-1,3-Dichloropropene	EPA 524.2	EPA 524.2	1	100%	ug/L
79-01-6	Trichloroethene	EPA 524.2	EPA 524.2	1	96%	ug/L
75-69-4	Trichlorofluoromethane	EPA 524.2	EPA 524.2	1	98%	ug/L
75-01-4	Vinyl Chloride	EPA 524.2	EPA 524.2	1	100%	ug/L
Metals						
7429-90-5	Aluminum	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	17	100%	ug/L
7440-36-0	Antimony	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	1	54%	ug/L
7440-38-2	Arsenic	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	1	44%	ug/L
7440-39-3	Barium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	100	100%	ug/L
7440-41-7	Beryllium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	1	100%	ug/L
7440-43-9	Cadmium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	0.3	48%	ug/L
7440-70-2	Calcium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	5000	100%	ug/L
7440-47-3	Chromium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	2	100%	ug/L
7440-48-4	Cobalt	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	50	100%	ug/L
7440-50-8	Copper	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	3	100%	ug/L
7439-89-6	Iron	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	100	100%	ug/L
7439-92-1	Lead	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	1	66%	ug/L
7439-93-2	Lithium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	100	100%	ug/L
7439-95-4	Magnesium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	5000	100%	ug/L
7439-96-5	Manganese	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	15	100%	ug/L
7439-97-6	Mercury	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	0.1	93%	ug/L
7439-98-7	Molybdenum	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	30	100%	ug/L
7440-02-0	Nickel	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	20	100%	ug/L
7440-09-7	Potassium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	5000	100%	ug/L
7782-49-2	Selenium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	1	45%	ug/L
7440-22-4	Silver	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	0.1	55%	ug/L
7440-23-5	Sodium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	5000	100%	ug/L
7440-24-6	Strontium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	200	100%	ug/L
7440-28-0	Thallium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	0.5	59%	ug/L
7440-31-5	Tin	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	200	100%	ug/L
11-09-6	Uranium	CLP-SOW-Dissolved	CLP-SOW (Dissolved)	NR	NR	ug/L
7440-62-2	Vanadium	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	40	100%	ug/L
7440-66-6	Zinc	CLP-SOW-Dissolved	CLP-SOW (Diss. & Total)	20	100%	ug/L
Radionuclides						
14596-10-2	Americium-241	Alpha Spec. (EPA A-001)	Alpha Spec. (EPA A-001)	0.03	100%	pCi/L
10-12-8	Plutonium-239/240	Alpha Spec. (EPA A-001)	Alpha Spec. (EPA A-001)	0.03	100%	pCi/L
11-10-9	Strontium-89/90	Gas Flow (EPA 900.0)	Gas Flow (EPA 900.0)	1	100%	pCi/L
10028-17-8	Tritium	Liquid Scint. (EPA A-002)	Liquid Scint. (EPA A-002)	400	100%	pCi/L
11-08-5	Uranium-233/234	Alpha Spec. (EPA A-001)	Alpha Spec. (EPA A-001)	1	100%	pCi/L
15117-96-1	Uranium-235	Alpha Spec. (EPA A-001)	Alpha Spec. (EPA A-001)	1	100%	pCi/L
7440-61-1	Uranium-238	Alpha Spec. (EPA A-001)	Alpha Spec. (EPA A-001)	1	100%	pCi/L
Water Quality Parameters						
16984-48-8	Fluoride	EPA 300.0	EPA 300.0	0.5	100%	mg/L
C-005	Nitrate/Nitrite	EPA 353.1	EPA 353.1	0.05	63%	mg/L
10-33-3	Total Dissolved Solids	EPA 160.1	EPA 160.1	10	100%	mg/L
14808-79-8	Sulfate as SO_4	EPA 375.1	EPA 375.1, 300.0	5	63%	mg/L

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Table 2-5
Rinsate QC Results with Detections
Groundwater 1999

Location	Sample Date	Sample Number	Analyte	Tier 2	Result	Units	Lab Qual.	Detect Limit	Dilution	Validation Qual.
Volatile Organic Compounds										
02291	12/4/98	GW06194TE	Methylene Chloride	5	2	ug/L	B	1	1	UJ
02397	11/5/98	GW06171TE	Chloromethane	2.32	0.9	ug/L	J	1	1	J1
02397	11/5/98	GW06171TE	Methylene Chloride	5	4	ug/L	B	1	1	UJ1
05091	8/26/98	GW05924TE	Chloromethane	2.32	0.9	ug/L	J	1		V1
05091	8/26/98	GW05924TE	Trichloroethene	5	0.7	ug/L	J	1		J1
10498	8/19/98	GW06077TE	Methylene Chloride		0.7	ug/L	J	1		J1
12191	12/15/98	GW06140TE	Toluene	1000	0.5	ug/L	J	1	1	J
3586	10/20/98	GW06148TE	Methylene Chloride	5	0.9	ug/L	BJ	1	1	JB1
891COLGAL	8/20/98	GW06069TE	Methylene Chloride	5	0.7	ug/L	J	1		J1
891COLGAL	8/20/98	GW06069TE	Trichloroethene	5	0.7	ug/L	J	1		V1
891COLWEL	8/20/98	GW06068TE	Trichloroethene	5	0.5	ug/L	J	1		V1
P209489	5/14/98	GW06005TE	Chloromethane	2.32	0.7	ug/L	J	1		V1
P209489	5/14/98	GW06005TE	Trichloroethene	5	0.7	ug/L	J	1		V1
SW13494	8/19/98	GW06067TE	Methylene Chloride	5	0.5	ug/L	J	1		J1
Metals										
02291	12/4/98	GW06194TE	Thallium	2	2	ug/L	N	0.15	1	UJ1
03991	8/6/98	GW05917TE	Cadmium	5	2.6	ug/L	N	0.05		J1
10498	8/12/98	GW06066TE	Aluminum	106000	39.3	ug/L	E	0.25		UJ1
11891	6/11/98	GW05942TE	Aluminum	106000	23	ug/L	*	10		UJ1
11891	6/11/98	GW05942TE	Zinc	11000	22	ug/L	E	0.1		J1
70193	11/30/98	GW06189TE	Thallium	2	2.5	ug/L	N	0.15	1	UJ1
891COLWEL	8/20/98	GW06068TE	Aluminum	106000	77.7	ug/L	E	0.25		J1
891COLWEL	8/20/98	GW06068TE	Selenium	50	1	ug/L	N	0.20		J1
P209489	5/14/98	GW06005TE	Aluminum	106000	42.7	ug/L	E	0.25		J1
P209489	5/14/98	GW06005TE	Lead	15	1.6	ug/L	EN	0.05		J1
SW13494	8/19/98	GW06067TE	Aluminum	106000	27.1	ug/L	E	0.25		UJ1
Radionuclides										
02291	12/4/98	GW06194TE	Uranium-238	0.768	0.276	pCi/L	J	0.068		V
03991	8/6/98	GW05917TE	Americium-241	0.145	0.014	pCi/L	J	0.005		V1
03991	8/6/98	GW05917TE	Uranium-238	0.768	0.172	pCi/L	J	0.078		V1
11891	3/5/98	GW05805TE	Plutonium-239/240	0.151	0.026	pCi/L	J	0.015		
11891	6/11/98	GW05942TE	Americium-241	0.145	0.0101	pCi/L	J	0.0031		V
11891	11/19/98	GW06176TE	Uranium-233/234	1.07	0.194	pCi/L	J	0.066		V1
12191	4/28/98	GW05946TE	Plutonium-239/240	0.151	0.0093	pCi/L	J	0.005		V1
12191	4/28/98	GW05946TE	Uranium-233/234	1.07	0.4115	pCi/L	J	0.0484		V1
12191	4/28/98	GW05946TE	Uranium-238	0.768	0.1073	pCi/L	J	0.0484		V1
12191	12/15/98	GW06140TE	Americium-241	0.145	0.015	pCi/L	J	0.014		V1
12191	12/15/98	GW06140TE	Plutonium-239/240	0.151	0.004	pCi/L	J	0.004		V1
12191	12/15/98	GW06140TE	Uranium-238	0.768	0.073	pCi/L	J	0.066		V1
3586	3/16/98	GW05818TE	Plutonium-239/240	0.151	0.15	pCi/L	J	0.088		
3586	6/5/98	GW05966TE	Americium-241	0.145	0.0087	pCi/L	J	0.0037		V
3586	6/5/98	GW05966TE	Uranium-233/234	1.07	0.1029	pCi/L	J	0.0309		V
70193	7/14/98	GW05989TE	Uranium-233/234	1.07	0.1206	pCi/L	J	0.0544		V1
70193	11/30/98	GW06189TE	Uranium-233/234	1.07	0.163	pCi/L	J	0.063		V
P209489	5/14/98	GW06005TE	Plutonium-239/240	0.151	0.0141	pCi/L	J	.0047		

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Table 2-5
Rinsate QC Results with Detections
Groundwater 1999

Location	Sample Date	Sample Number	Analyte	Tier 2	Result	Units	Lab Qual.	Detect Limit	Dilution	Validation Qual.
Water Quality Parameters										
03991	8/6/98	GW05917TE	Nitrate/Nitrite	10	0.05	mg/L		0.05		V1
03991	8/6/98	GW05917TE	Total Diss Solids		12	mg/L		10		V1
05091	8/26/98	GW05924TE	Total Diss Solids		24	mg/L		10		V1
11891	11/19/98	GW06176TE	Total Diss Solids		10	mg/L		10		V1
12191	4/28/98	GW05946TE	Total Diss Solids		18	mg/L		10		
3586	10/20/98	GW06148TE	Nitrate/Nitrite	10	1.3	mg/L		0.05	5	V1

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Other aspects of representativeness such as numbers of samples and spatial distribution are fixed in the IMP (K-H, 1998a). All wells that were required to be sampled were visited in 1998. Plate 1 presents the locations sampled for reference to the spatial distribution of the samples.

Completeness

Table 2-6 compares the actual number of samples collected in 1998 to the required number of samples. As a result of dry wells or wells with such low productivity as to prohibit sample collection, the completeness goal of 90% was not met for any of the analyte groups.

Completeness is a quantitative measure of data quality expressed as the percentage of valid or acceptable data obtained from a measurement system. Table 2-7 summarizes the validation completeness evaluation. Detailed validation and verification data for all analytes and samples are provided in the 1998 quarterly reports (RMRS 1998a, 1998b, 1999a, and 1999b). A completeness metric was calculated using the following formula:

$$\text{Completeness} = \quad Dp_u = \frac{DP_t - DP_n}{DP_t} \times 100 \text{ (in percent)}$$

The completeness criterion is $\geq$ 90%.

Where:

Dp_u = Percentage of usable data points
DP_n = Non-usable data points
DP_t = Total number of data points

Comparability

During 1998 planned analytical methods for VOCs, water quality parameters, and radionuclides remained consistent over the entire year (see below for metals). Table 2-4 lists the required methods for the various analytes. Laboratory analyses were performed according to standard CLP protocols and results should be comparable to data produced by similar methods.

In the third quarter of 1998, sampling procedure was modified in order to reduce the amount of purge water generated at certain wells and also enhance the quality of the samples collected. Some wells with adequate recharge rates have had submersible pumps installed. Pump equipped wells allow for micropurging at the time of sampling. Micropurging, where pump discharge rates are set low to prevent an increase in turbidity, has several advantages. Less water is needed to purge the pump system compared to purging with a bailer, and there is less purge water to dispose of. Because the pump intake port is placed opposite the center of the screened interval in the well, collection of water entering the well bore directly from the aquifer minimizes the dilution of the formation water with stagnant well water.

Table 2-6
Comparison of Required and Actual Samples Collected
Groundwater 1998

Sample Types		Required Number of Visits	Actual Number of Visits*	Actual Number of Samples Collected	Deviation	Percent of Samples Successfully Collected (or Wells Visited)	Discrepancy Justification
Groundwater Wells (Visits)		232	232	NA	0	100.0	NA
VOC's		232	232	200	-32	86.2	Dry
Metals		202	202	151	-51	74.8	Dry or Insw
Radionuclides							
	Pu/Am	126	126	82	-44	65.1	Dry or Insw
	U-isotope	204	204	145	-59	71.1	Dry or Insw
	Tritium	83	83	54	-29	65.1	Dry or Insw
	Strontium	46	46	17	-29	37.0	Dry or Insw
Water Quality Parameters							
	Nitrate	186	186	148	-38	79.6	Dry or Insw
	TDS	211	211	148	-63	70.1	Dry or Insw
	Sulfate	125	125	71	-54	56.8	Dry or Insw
	Fluoride	93	93	50	-43	53.8	Dry or Insw

*Does not reflect multiple visits to dry wells.
Dry = Well did not recharge after purging. No samples collected.
Insw = Insufficient water to collect complete sample suite.

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Table 2-7
Summary of Validation and Verification Completeness
Groundwater 1998

	All Analyses	VOC's	Metals			Radionuclides					Water Quality Parameters				
			SUM	Diss.	Total	SUM	U-iso	Pu/Am	Tritium	$Sr_{89/90}$	SUM	NO_3/NO_2	TDS	SO_4	Fluoride
Total number of Data Points (DP_t)	20595	14659	4506	3939	567	919	588	226	88	17	511	187	182	81	61
Usable Data Points (Dp_u)	20129	14281	4419	3853	566	918	588	225	88	17	511	187	182	81	61
Non-usable Data Points (DP_n)	466	378	87	86	1	1	0	1	0	0	0	0	0	0	0
Percent of Usable Data Points	97.7%	97.4%	98.1%	97.8%	99.8%	100%	100%	99.6%	100%	100%	100%	100%	100%	100%	100%
Data Validation or Verification not Provided	5106	3775	715	715	0	485	319	111	45	10	131	38	50	24	19
Data Points Validated	1502	726	640	480	160	136	89	37	8	2	0	0	0	0	0
Percent of Total Data Points	7.3%	5.0%	14.2%	12.2%	28.2%	14.8%	15.1%	16.4%	9.1%	11.8%	0.0%	0.0%	0.0%	0.0%	0.0%
Data Points Verified	12606	8778	3151	2746	405	297	180	77	35	5	380	149	132	57	42
Percent of Total Data Points	61.2%	59.9%	69.9%	69.7%	71.4%	32.3%	30.6%	34.1%	39.8%	29.4%	74.4%	79.7%	72.5%	70.4%	68.9%
Percent of Total Data Points Validated or Verified	68.5%	64.8%	84.1%	81.9%	100%	47.1%	45.7%	50.4%	48.9%	41.2%	74.4%	79.7%	72.5%	70.4%	68.9%

Usable data points contain verification qualifiers J1, JB1, U1, UJ1, or V1.
Usable data points contain validation qualifiers J, JB, U, UJ, or V.
Non-usable data points contain the validation/verification qualifiers R or R1.
Based on the high percentage of Usable Data Points, data that have not been validated or verified are considered usable.

QC criteria defined in IMP:

Percent of usable data points >90%.
Percent of total number of data points validated >25%
Percent of total number of data points verified >75%

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Finally, because of low pump discharge rates and consequent minimal mixing in the well bore, low turbidity samples may be collected without filtering.

The installation of submersible pumps and initiation of micropurging without sample filtering resulted in a change in analytical method for metals. Pump equipped wells are sampled and analyzed for total metals because no filter is used during sample collection. Analyses of this type correspond to line item code SS05B001 and analytical method CLP-SOW-Total. Bailed well samples are analyzed for dissolved metals using line item code SS05B007 and analytical method CLP-SOW-Dissolved.

2.2 Discussion of Analyte Groups

2.2.1 Metals

Precision

There were 184 real/duplicate pair samples within the 1495 real sample records in the data set for metals in 1998 (1 in 8.125). Of the 184 real/duplicate pairs there were 114 instances of detections in which a RPD could be calculated (Table 2-1). One hundred and five of the calculated RPDs were within the QC criterion of 30% (Table 2-2). With 92.1% of the RPDs meeting the QC criterion, precision for dissolved metal analysis is within the acceptable goal of 85%.

The recommended frequency for duplicate samples is 1 in 20 on a per-well basis. In 1998, 14 of 202 wells sampled were analyzed for metals as real/duplicate pairs, a ratio of 1 in 14.2. Thus duplicate sample frequency was within the requirements on both a per-well and per-analysis basis.

Accuracy

All metal analyses were performed using contract-required methods during 1998. Contract- required methods stipulate the CLP-SOW method for analysis of dissolved metals. As shown on Table 2-4, analyses were run using this method for all samples. Additional analyses were run using CLP-SOW for total metals. The total metals analyses were run as necessary in support of various groundwater evaluations, and to analyze samples collected with dedicated pumps using the low-flow (micropurging) techniques described in Section 2.1. Based on the Table 2-4 summary, methods used during 1998 for analysis of metals meet or exceed the requirements of RF/RMRS-98-200, *Evaluation of Data for Usability in Final Reports, August 1998.*.

Table 2-4 presents a summary of the comparison of required to actual detection limits for analyses of samples collected in 1998. Reported detection limits (RDLs) for nineteen metals were at or below CRDLs for 100 percent of the analyses performed. Eight analytes had RDLs for which some percentage of the analyses were above CRDLs. The analytes were, antimony with acceptable RDLs in 54% of the analyses, arsenic (44%), cadmium (48%), lead (66%), mercury (93%), selenium (45%), silver (55%), and thallium (59%). Discussion and data accuracy evaluations for specific samples and analyses are presented in the quarterly reports.

Representativeness

There were 434 rinsate records versus 4449 real sample records for metals in 1998 (1 in 10.25). Most metals rinsate results were either "U" (non-detection) or "B" (detection was less than the CRDL but greater than the IDL) qualified indicating that in general no metals contamination was introduced during sampling and/or shipping activities. As shown on Table 2-5, metals were detected in 11 rinsate analyses. All but two analyses (thallium at Wells 02291 and 70193) yielded results below Tier II limits.

Completeness

The Integrated Monitoring Plan (DOE, 1998) requires that samples be analyzed for metals in 98 wells. Sampling for metals was attempted in all the required wells during 1998 (Table 2-1). Eleven wells were dry or went dry during sampling; resulting in 51 metals samples that could not be collected. Of the 202 metals sample events required by the IMP, 151 were successfully completed during 1998, a success rate of 74.8% (Table 2-6). The goal, which assumes adequate groundwater production from the monitoring wells, is at least 90% successfully sampled.

Validation of metals results was performed on 14.2% (640 of 4,506 analyses), which is below the 25% criterion defined in the IMP. The verification rate of 69.9% (3,151 of 4,506 analyses) was also below the verification criterion of 75% (Table 2-7). A total of 715 metals analyses were neither validated nor verified. Of the analyses that were validated or verified, 87 were rejected (R-validated, or R1-verified), and 3,704 analyses were judged to be acceptable and usable. Because of the relatively low number of rejected analyses, the 715 records not validated or verified are considered adequate for calculating the percentage of usable metals data. Consequently, the metals results were found to be acceptable for 98.1% (4,419 or 4,506) of the analyses (Table 2-7). The assumption is made that the 715 records can be considered usable since the percentage of rejected data of 2.2%(87 of 3,791 analyses) is small.

Comparability

No changes were made to analytical procedures during 1998. Thus analyses from 1998 are comparable to previous analyses.

2.2.2 Radionuclides

Precision

The data set for dissolved radionuclides contains 396 duplicate records versus 677 real records (1 in 1.71). A DER could be calculated for 88 of the 396 duplicate/real pairs (Table 2-2). All but one of the DER values (U-238 in Well 10294 at 2.69pCi/L) is below the 1.96 precision limit. As shown on Table 2-3, the precision metric was met in 98.9% of radionuclide duplicate/real samples.

Accuracy

All radionuclide analyses were performed using the proper contract required methods during 1998 (Table 2-4). With respect to analytical methods, the 1998 results are accurate.

Required detection limits for the 677 radionuclide analyses performed during 1998 were met in all cases (Table 2-4). As such, the accuracy of radionuclide analyses is good.

Representativeness

There were 84 rinsate records from radionuclide samples collected at 10 locations in 1998 (Table 2-5). Eighteen rinsate analyses yielded detectable values. All, however, were below Tier II Action Levels. Based on 79% of rinsate results being undetected, there is little indication of introduced contamination during sampling activities being a concern for 1998 radionuclide data.

Completeness

As shown on Table 2-6, 126 plutonium/americium, 204 uranium isotope, 83 tritium, and 46 strontium$_{89/90}$ samples were to have been collected for analyses. All the required samples were collected or attempted. The success rate varied due to dry wells or wells that went dry during sampling. The percentages of successful sample collection were 65.1% for Pu/Am, 71.1% for U-isotopes, 65.1% for tritium, and 37% for strontium $_{89/90}$. The goal is 90%, groundwater conditions permitting.

Of 919 radionuclide analyses, 14.8% (136) were validated and 32.3% (297) were verified (Table 2-7). Both percentages are below the 25% validation and 75% verification criteria. Only one analysis (0.02%) of the 433 that were validated or verified was rejected. Data validation or verification was provided for 47.1% of the radionuclide analyses. As shown on Table 2-7, 99.99% (918 of 919) of radionuclide analyses are usable. With the caveat that not all validation and verification data were provided, the radionuclide analyses are thought to be complete.

Comparability

No changes were made to analytical procedures during 1998. Thus the radionuclide analyses presented here are assumed to be comparable to previous analyses.

2.2.3 Volatile Organic Compounds

Precision

There were 1,540 duplicate records versus 11,964 real records for VOCs in 1998, representing a ratio of 1 in 7.7 analyses. RPDs were calculated for the 102 duplicate/real pairs that had detections (Table 2-2). Eighty-five RPD values were less than the QC criterion of 30%, which equates to 83.3% meeting the QC criterion during 1998 (Table 2-3). As can be seen on Table 2-2, the majority of VOC RPD values above 30% are for samples with concentration at or near CRDLs, where analytical precision is inherently low. Given that consideration, the analyses of VOCs for 1998 are adequately precise.

Accuracy

All VOC analyses performed in 1998 employed contract-required methods (Table 2-4). With respect to analytical methods, the results are accurate.

As shown on Table 2-4, the majority of the 60 VOCs analyzed in 1998 met CRDLs. The range was between 96% and 100%, with an average of 98.7%.

The higher than required CRDLs for some VOCs result from several wells that are known to contain significant concentrations of VOCs. The laboratories run dilution analyses for samples from those wells. To protect instrumentation, the laboratories do not run 1x dilutions on the samples from wells having significant VOC contamination. CRDLs were not met for any of the VOC analytes from samples collected at those wells. Further discussion and additional data are provided in the quarterly reports (RMRS 1998a, 1998b, 1999a, and 1999b).

Representativeness

There were 1,099 rinsate records from 13 wells for VOCs in 1998. Of those records, 14 rinsate analyses contained VOCs at detectable concentrations (Table 2-5). Considering all rinsate analyses, 98.7% yielded non-detectable concentrations. As such, the VOC samples are judged to be representative.

Completeness

During 1998, the required 232 VOCs samples were collected or attempted (Table 2-6). Of those, 200 samples were collected, yielding a success rate of 86.2%. Because dry well conditions precluded collection of 32 samples, the goal of 90.0% was not reached for VOCs in 1998.

There were 14,659 VOC analyses performed in 1998. Of those, 5.0% of the analyses (726) were validated, and 59.9% (8,778) were verified (Table 2-7). Both percentages are below the 25% validation and 75% verification criteria. Of the 9,505 analyses for which validation or verification was performed, 4.0% (378) were rejected and are considered unusable data. Overall, 97.4% of VOC analyses are usable, assuming that the 3,778 analyses that were not validated or verified are usable.

Comparability

As stated above, no changes were made to analytical procedures during 1998. Thus the VOC analyses presented here are assumed to be comparable to previous analyses.

2.2.4 Water Quality Parameters

Precision

There were 50 duplicate sample records versus 427 real sample records for collected water quality parameters during 1998 (1 in 8.5). Forty-eight of the real/duplicate pairs could be used to calculate RPD values (Table 2-2). As shown on Table 2-3, 47 of the values (97.9%) were within the QC criterion of 30%. The one RPD that was greater than the criterion was calculated for the real/duplicate pair for nitrate/nitrite at Well 11891. Review of the analytical data indicates that the sample had a concentration that was two orders of magnitude higher than historical concentrations at that well. Samples collected in quarters immediately before and after had concentrations that were comparable to historical concentrations. As such, the elevated concentration appears to be a single anomalous value. Overall, the data indicates good precision for water quality parameter analyses.

Accuracy

All water quality parameter analyses were performed using the proper contract required analytical methods in 1998 (Table 2-4). With respect to methods, the results for the first quarter are accurate.

Analytical data indicate that the contract-required detection limits were met for all analyses of fluoride and total dissolved solids (TDS)(Table 2-4). The CRDL for nitrate/nitrite and sulfate (as SO_4) were met in 63% of the analyses.

Representativeness

There were 37 equipment rinsate analyses for water quality parameters in 1998. Thirty-one of the analyses were non-detects. As shown on Table 2-5, two nitrate/nitrite rinsate analyses and four TDS analyses had detectable concentrations. Neither of the nitrate/nitrite concentrations were above Tier II

Action Levels. The water quality parameter analyte group yielded non-detectable results in 83.4% of the rinsate analyses. No significant introduced contamination is indicated.

Completeness

As shown on Table 2-6, 186 nitrate/nitrite, 211 TDS, 125 sulfate, and 93 fluoride samples were to have been collected for analysis. All of the required samples were collected or attempted to be collected. The success rate varied because of dry wells or wells that went dry during sampling. The percentages of successful sample collection were 79.6% for nitrate/nitrite, 70.1% for TDS, 56.8% sulfate, and 53.8% fluoride. The goal is 90%, groundwater conditions permitting.

None of the 511 water quality parameter analyses performed in 1998, were validated. Verification was done on 74.4% (380) analyses (Table 2-7). As such, data validation or verification was provided for 74.4% of the water quality parameter results. As shown on Table 2-7, all of the analyses were verified as usable. Given that there were no rejected data, and that the 131 unvalidated and unverified analyses are acceptable, 100% of the 1998 water quality parameter data are usable.

Comparability

As stated above no changes were made to analytical procedures during 1998. Thus the water quality parameter analyses presented here are assumed to be comparable to previous analyses.

2.3 Data Summary for RFCA-Designated Wells Sampled in 1998

2.3.1 Data Screening

RFCA groundwater analytical data for 1998 were utilized for assessing compliance with RFCA well classifications as set forth in the data quality objectives section of the IMP. As most well catagories rely on Tier I or Tier II action level criteria to trigger further action, the Tier II action level criteria have been adopted for reducing the data set to a manageable size for presentation and discussion. Non-Tier I and Tier II action level based well categories, including D&D and RCRA monitoring well networks, are evaluated separately in Section 2.3.3 using an upgradient to downgradient groundwater quality comparison approach. Although performance monitoring wells do not employ Tier I or Tier II action levels for determining a course of action, these criteria were used to select contaminants for assessing trends consistent with the DQO requirements for this well category.

Table 2-8 presents a summary of results for contaminants with concentrations greater than Tier II action levels. These values have been previously reported in the 1998 RFCA Quarterly Groundwater Monitoring Reports (RMRS, 1998a, 1998b, 1999a, 1999b). In total, seventy two RFCA-designated monitoring wells (excluding RCRA and D&D wells) had concentrations of one or more analytes above Tier II action levels, while 14 RFCA-designated wells yielded no results above Tier II action levels. Plates 4 through 6 are box plots that display the results of selected analytes (i.e., radionuclides, VOCs, and water quality parameters) at monitoring wells that had at least one analyte above Tier II action levels. The wells with contaminant concentrations below Tier II action levels (excluding RCRA and D&D wells) are listed in Table 2-9. A listing of all analytical results from RFCA-designated wells are provided in the quarterly reports.

Historical trends of contaminants of concern for selected Boundary, Drainage, Performance Monitoring, Plume Definition, and Plume Extent wells are shown in Figures 2-1 through 2-59. The contaminant trend plots for Boundary, Drainage, Plume Definition, and Plume Extent wells were chosen from organic compounds that exceeded Tier I and II action levels, and other analytes that exceeded both Tier I and II action levels and background M2SD concentrations. Background values for inorganics and radionuclides were adopted from the 1993 Background Geochemical Characterization Report (DOE, 1993b) and the draft Background Comparison for Radionuclides in Groundwater (DOE, 1997a). Trend plots of contaminants found in Performance monitoring wells were generally chosen for the contaminants with the highest Tier II ratios. The following sections present a compilation of the data and information first provided in the quarterly reports.

The decision rules that are described in general terms in Section 1.3 define the conditions under which values above action levels become "Reportable".

2.3.2 Values Above Tier I and Tier II Action Level Criteria

2.3.2.1 Boundary Wells

Six RFCA designated Boundary wells, 0386, 06491, 10294, 10394, 41591, and 41691, were sampled in 1998. Only sulfate, detected in well 10294, was above the Tier II action level and the background M2SD benchmark. Although the values are reportable, concentrations have remained below historic M2SD, and trends have not been upward (Table 2-8 and Figure 2-1).

Table 2-8 1998 Groundwater Values Above Tier II Action Levels and Standard Framework Criteria (ALF) in RFCA - Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II	Tier II Ratio	Back-ground M2SD	Back-ground Ratio	Above Back-ground?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?	Well Class
Boundary	0386	2/26/98	Uranium-233/234	10.30	pCi/L		1.07	9.63	60.7	0.17					No	Boundary
	0386	2/26/98	Uranium-238	8.35	pCi/L		0.768	10.87	41.8	0.20					No	Boundary
	0386	8/25/98	Uranium-233/234	10.80	pCi/L		1.07	10.09	60.7	0.18					No	Boundary
	0386	8/25/98	Uranium-238	8.23	pCi/L		0.768	10.72	41.8	0.20					No	Boundary
	06491	2/19/98	Uranium-233/234	27.80	pCi/L		1.07	25.98	60.7	0.46					No	Boundary
	06491	2/19/98	Uranium-235	1.17	pCi/L		1.01	1.16	1.79	0.65					No	Boundary
	06491	2/19/98	Uranium-238	18.00	pCi/L		0.768	23.44	41.8	0.43					No	Boundary
	06491	7/20/98	Uranium-233/234	27.56	pCi/L		1.07	25.75	60.7	0.45					No	Boundary
	06491	7/20/98	Uranium-238	17.22	pCi/L		0.768	22.43	41.8	0.41					No	Boundary
	10294	2/10/98	Sulfate	830.00	mg/L		500	1.66	435.6	1.91	Yes	700	1.19	Yes	Yes	Boundary
	10294	2/10/98	Uranium-233/234	27.90	pCi/L		1.07	26.07	60.7	0.46					No	Boundary
	10294	2/10/98	Uranium-238	24.00	pCi/L		0.768	31.25	41.8	0.57					No	Boundary
	10294	7/29/98	Uranium-233/234	21.61	pCi/L		1.07	20.20	60.7	0.36					No	Boundary
	10294	7/29/98	Uranium-235	1.18	pCi/L		1.01	1.17	1.79	0.66					No	Boundary
	10294	7/29/98	Uranium-238	16.59	pCi/L		0.768	21.60	41.8	0.40					No	Boundary
	10394	7/27/98	Uranium-233/234	3.42	pCi/L		1.07	3.19	60.7	0.06					No	Boundary
	10394	7/27/98	Uranium-238	2.35	pCi/L		0.768	3.05	41.8	0.06					No	Boundary
	41591	2/26/98	Uranium-233/234	10.90	pCi/L		1.07	10.19	60.7	0.18					No	Boundary
	41591	2/26/98	Uranium-238	8.20	pCi/L		0.768	10.68	41.8	0.20					No	Boundary
	41591	8/27/98	Uranium-233/234	9.61	pCi/L		1.07	8.98	60.7	0.16					No	Boundary
	41591	8/27/98	Uranium-238	9.17	pCi/L		0.768	11.94	41.8	0.22					No	Boundary
	41691	3/11/98	Uranium-233/234	1.10	pCi/L		1.07	1.03	60.7	0.02					No	Boundary
	41691	3/11/98	Uranium-238	0.89	pCi/L	J	0.768	1.15	41.8	0.02					No	Boundary
	41691	7/30/98	Uranium-233/234	1.56	pCi/L		1.07	1.46	60.7	0.03					No	Boundary
	41691	7/30/98	Uranium-238	1.89	pCi/L		0.768	2.47	41.8	0.05					No	Boundary
Drainage	00997	3/3/98	Uranium-233/234	13.30	pCi/L		1.07	12.43	60.7	0.22					No	Drainage
	00997	3/3/98	Uranium-238	8.34	pCi/L		0.768	10.86	41.8	0.20					No	Drainage
	00997	7/27/98	Uranium-233/234	5.76	pCi/L		1.07	5.39	60.7	0.09					No	Drainage
	00997	7/27/98	Uranium-238	4.30	pCi/L		0.768	5.59	41.8	0.10					No	Drainage
	38591	2/24/98	Uranium-233/234	18.90	pCi/L		1.07	17.66	60.7	0.31					No	Drainage
	38591	2/24/98	Uranium-238	12.10	pCi/L		0.768	15.76	41.8	0.29					No	Drainage
	5587	5/20/98	Methylene Chloride	6.00	ug/L	B	5	1.20				8.1	0.74		No	Drainage
	6486	2/24/98	Nickel	151.00	ug/L		100	1.51	21.37	7.07	Yes	62.02	2.43	Yes	Yes	Drainage
	6486	2/25/98	Uranium-233/234	5.05	pCi/L		1.07	4.72	60.7	0.08					No	Drainage
	6486	2/25/98	Uranium-238	3.16	pCi/L		0.768	4.11	41.8	0.08					No	Drainage
	6486	7/14/98	Uranium-233/234	7.61	pCi/L		1.07	7.11	60.7	0.13					No	Drainage
	6486	7/14/98	Uranium-238	4.19	pCi/L		0.768	5.45	41.8	0.10					No	Drainage
	6586	6/18/98	Nickel	871.00	ug/L		100	8.71	21.37	40.76	Yes	78.78	11.06	Yes	Yes	Drainage
	6586	7/28/98	Nickel	603.00	ug/L		100	6.03	21.37	28.22	Yes	78.78	7.65	Yes	Yes	Drainage
	6586	7/28/98	Uranium-233/234	2.05	pCi/L		1.07	1.92	60.7	0.03					No	Drainage
	6586	7/28/98	Uranium-238	1.91	pCi/L		0.768	2.49	41.8	0.05					No	Drainage
	6586	8/24/98	Nickel	570.00	ug/L		100	5.70	21.37	26.67	Yes	78.78	7.24	Yes	Yes	Drainage
Performance Monitoring	00797	2/23/98	Sulfate	507.00	mg/L		500	1.01	435.6	1.16	Yes				No	Perf Monitoring
	00797	2/23/98	Uranium-233/234	8.67	pCi/L		1.07	8.10	60.7	0.14					No	Perf Monitoring
	00797	2/23/98	Uranium-238	7.55	pCi/L		0.768	9.83	41.8	0.18					No	Perf Monitoring
	00797	7/29/98	Uranium-233/234	9.53	pCi/L		1.07	8.90	60.7	0.16					No	Perf Monitoring
	00797	7/29/98	Uranium-238	8.31	pCi/L		0.768	10.82	41.8	0.20					No	Perf Monitoring
	00897	3/9/98	Tetrachloroethene	14000.00	ug/L		5	2800.00							No	Perf Monitoring
	00897	3/9/98	Trichloroethene	2000.00	ug/L		5	400.00							No	Perf Monitoring
	00897	3/9/98	Uranium-233/234	3.96	pCi/L		1.07	3.70	60.7	0.07					No	Perf Monitoring
	00897	3/9/98	Uranium-238	2.61	pCi/L		0.768	3.40	41.8	0.06					No	Perf Monitoring
	00897	6/16/98	Methylene Chloride	12000.00	ug/L		5	2400.00							No	Perf Monitoring
	00897	6/16/98	Tetrachloroethene	20000.00	ug/L		5	4000.00							No	Perf Monitoring
	00897	6/16/98	Trichloroethene	2000.00	ug/L	J	5	400.00							No	Perf Monitoring
	00897	6/16/98	Uranium-233/234	4.92	pCi/L		1.07	4.59	60.7	0.08					No	Perf Monitoring
	00897	6/16/98	Uranium-238	2.84	pCi/L		0.768	3.69	41.8	0.07					No	Perf Monitoring
	00897	11/19/98	Tetrachloroethene	7400.00	ug/L	D	5	1480.00							No	Perf Monitoring
	00897	11/19/98	Trichloroethene	990.00	ug/L	D	5	198.00							No	Perf Monitoring
	00897	11/19/98	Uranium-233/234	3.57	pCi/L	B	1.07	3.34	60.7	0.06					No	Perf Monitoring
	00897	11/19/98	Uranium-238	2.88	pCi/L	B	0.768	3.75	41.8	0.07					No	Perf Monitoring
	02291	3/10/98	Tetrachloroethene	4200.00	ug/L		5	840.00				4201.94	1.00	Yes	No	Perf Monitoring
	02291	3/10/98	Trichloroethene	660.00	ug/L		5	132.00				453.73	1.45	Yes	No	Perf Monitoring
	02291	3/10/98	Uranium-233/234	2.61	pCi/L		1.07	2.44	60.7	0.04					No	Perf Monitoring
	02291	3/10/98	Uranium-238	1.67	pCi/L		0.768	2.17	41.8	0.04					No	Perf Monitoring
	02291	5/22/98	Uranium-233/234	2.19	pCi/L		1.07	2.05	60.7	0.04					No	Perf Monitoring
	02291	5/22/98	Uranium-238	1.41	pCi/L		0.768	1.84	41.8	0.03					No	Perf Monitoring
	02291	12/4/98	Methylene Chloride	2100.00	ug/L	BD	5	420.00							No	Perf Monitoring
	02291	12/4/98	Tetrachloroethene	5700.00	ug/L	D	5	1140.00				4201.94	1.36	Yes	No	Perf Monitoring
	02291	12/4/98	Trichloroethene	620.00	ug/L	D	5	124.00				453.73	1.37	Yes	No	Perf Monitoring
	02291	12/4/98	Uranium-233/234	3.03	pCi/L		1.07	2.83	60.7	0.05					No	Perf Monitoring
	02291	12/4/98	Uranium-238	1.97	pCi/L	B	0.768	2.57	41.8	0.05					No	Perf Monitoring
	05691	3/9/98	Carbon Tetrachloride	98.00	ug/L		5	19.60				561.21	0.17		No	Perf Monitoring
	05691	3/9/98	Tetrachloroethene	23.00	ug/L		5	4.60				149.64	0.15		No	Perf Monitoring

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Table 2-8 1998 Groundwater Values Above Tier II Action Levels and Standard Framework Criteria (ALF) in RFCA - Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II	Tier II Ratio	Back-ground M2SD	Back-ground Ratio	Above Back-ground?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?	Well Class
Performance Monitoring	05691	3/9/98	Trichloroethene	11.00	ug/L		5	2.20				95.59	0.12		No	Perf Monitoring
	05691	3/9/98	Uranium-233/234	3.82	pCi/L		1.07	3.57	60.7	0.06					No	Perf Monitoring
	05691	3/9/98	Uranium-238	2.39	pCi/L		0.768	3.11	41.8	0.06					No	Perf Monitoring
	05691	7/13/98	Carbon Tetrachloride	100.00	ug/L		5	20.00				561.21	0.18		No	Perf Monitoring
	05691	7/13/98	Methylene Chloride	5.00	ug/L	J	5	1.00							No	Perf Monitoring
	05691	7/13/98	Tetrachloroethene	22.00	ug/L		5	4.40				149.64	0.15		No	Perf Monitoring
	05691	7/13/98	Uranium-233/234	2.36	pCi/L		1.07	2.21	60.7	0.04					No	Perf Monitoring
	05691	7/13/98	Uranium-238	1.72	pCi/L		0.768	2.23	41.8	0.04					No	Perf Monitoring
	05691	9/29/98	Carbon Tetrachloride	130.00	ug/L	D	5	26.00				561.21	0.23		No	Perf Monitoring
	05691	9/29/98	Tetrachloroethene	29.00	ug/L	D	5	5.80				149.64	0.19		No	Perf Monitoring
	05691	9/29/98	Trichloroethene	16.00	ug/L	D	5	3.20				95.59	0.17		No	Perf Monitoring
	07391	3/17/98	Trichloroethene	27000.00	ug/L		5	5400.00				158350	0.17		No	Perf Monitoring
	07391	3/17/98	Uranium-233/234	20.00	pCi/L		1.07	18.69	60.7	0.33					No	Perf Monitoring
	07391	3/17/98	Uranium-238	49.20	pCi/L		0.768	64.06	41.8	1.18	Yes	43.4	1.13	Yes	Yes	Perf Monitoring
	07391	8/24/98	1,1,1-Trichloroethane	1700.00	ug/L		200	8.50				2724.6	0.62		No	Perf Monitoring
	07391	8/24/98	Chloroform	3000.00	ug/L	B	100	30.00				4439.22	0.68		No	Perf Monitoring
	07391	8/24/98	Chloroform	18000.00	ug/L	DB	100	180.00				4439.22	4.05	Yes	No	Perf Monitoring
	07391	8/24/98	Methylene Chloride	1200.00	ug/L	B	5	240.00							No	Perf Monitoring
	07391	8/24/98	Methylene Chloride	35000.00	ug/L	DB	5	7000.00							No	Perf Monitoring
	07391	8/24/98	Nitrate/Nitrite	17.00	mg/L		10	1.70	4.664	3.64	Yes	20	0.85		No	Perf Monitoring
	07391	8/24/98	Tetrachloroethene	3200.00	ug/L		5	640.00				3030.17	1.06	Yes	No	Perf Monitoring
	07391	8/24/98	Trichloroethene	160000.00	ug/L	D	5	32000.00				158350	1.01	Yes	No	Perf Monitoring
	07391	8/25/98	Uranium-233/234	25.60	pCi/L		1.07	23.93	60.7	0.42					No	Perf Monitoring
	07391	8/25/98	Uranium-235	1.29	pCi/L		1.01	1.28	1.79	0.72					No	Perf Monitoring
	07391	8/25/98	Uranium-238	58.70	pCi/L		0.768	76.43	41.8	1.40	Yes	43.4	1.35	Yes	Yes	Perf Monitoring
	10592	6/15/98	Selenium	137.00	ug/L		50	2.74	43.72	3.13	Yes	343.94	0.40		No	Perf Monitoring
	10592	6/15/98	Uranium-233/234	10.90	pCi/L		1.07	10.19	60.7	0.18					No	Perf Monitoring
	10592	6/15/98	Uranium-238	7.62	pCi/L		0.768	9.92	41.8	0.18					No	Perf Monitoring
	10592	11/16/98	Methylene Chloride	9.00	ug/L		5	1.80							No	Perf Monitoring
	10592	11/16/98	Selenium	126.00	ug/L		50	2.52	43.72	2.88	Yes	343.94	0.37		No	Perf Monitoring
	10592	11/16/98	Uranium-233/234	11.90	pCi/L	B	1.07	11.12	60.7	0.20					No	Perf Monitoring
	10592	11/16/98	Uranium-238	8.36	pCi/L	B	0.768	10.89	41.8	0.20					No	Perf Monitoring
	10692	2/27/98	Uranium-233/234	16.40	pCi/L		1.07	15.33	60.7	0.27					No	Perf Monitoring
	10692	2/27/98	Uranium-238	12.00	pCi/L		0.768	15.63	41.8	0.29					No	Perf Monitoring
	10692	7/15/98	Uranium-233/234	16.67	pCi/L		1.07	15.58	60.7	0.27					No	Perf Monitoring
	10692	7/15/98	Uranium-238	10.02	pCi/L		0.768	13.04	41.8	0.24					No	Perf Monitoring
	10792	5/20/98	Selenium	116.00	ug/L		50	2.32	43.72	2.65	Yes				No	Perf Monitoring
	10792	5/20/98	Uranium-233/234	4.49	pCi/L		1.07	4.20	60.7	0.07					No	Perf Monitoring
	10792	5/20/98	Uranium-238	2.87	pCi/L		0.768	3.74	41.8	0.07					No	Perf Monitoring
	10792	11/17/98	Selenium	59.40	ug/L		50	1.19	43.72	1.36	Yes				No	Perf Monitoring
	10792	11/17/98	Uranium-233/234	4.13	pCi/L	B	1.07	3.86	60.7	0.07					No	Perf Monitoring
	10792	11/17/98	Uranium-238	4.17	pCi/L	B	0.768	5.43	41.8	0.10					No	Perf Monitoring
	10792	12/9/98	Selenium	52.70	ug/L		50	1.05	43.72	1.21	Yes				No	Perf Monitoring
	10992	8/18/98	Nitrate/Nitrite	24.00	mg/L		10	2.40	4.664	5.15	Yes	37.16	0.65		No	Perf Monitoring
	10992	8/18/98	Selenium	371.00	ug/L	N	50	7.42	43.72	8.49	Yes				No	Perf Monitoring
	10992	8/19/98	Uranium-233/234	7.22	pCi/L		1.07	6.75	60.7	0.12					No	Perf Monitoring
	10992	8/19/98	Uranium-238	5.82	pCi/L		0.768	7.58	41.8	0.14					No	Perf Monitoring
	11092	11/17/98	Methylene Chloride	8.00	ug/L		5	1.60							No	Perf Monitoring
	11891	3/5/98	Carbon Tetrachloride	460.00	ug/L	D	5	92.00				737.11	0.62		No	Perf Monitoring
	11891	3/5/98	Tetrachloroethene	260.00	ug/L	D	5	52.00				319.91	0.81		No	Perf Monitoring
	11891	3/5/98	Trichloroethene	60.00	ug/L	D	5	12.00				407.56	0.15		No	Perf Monitoring
	11891	3/5/98	Uranium-233/234	2.32	pCi/L		1.07	2.17	60.7	0.04					No	Perf Monitoring
	11891	3/5/98	Uranium-238	1.58	pCi/L		0.768	2.06	41.8	0.04					No	Perf Monitoring
	11891	6/11/98	Carbon Tetrachloride	210.00	ug/L		5	42.00				737.11	0.28		No	Perf Monitoring
	11891	6/11/98	Tetrachloroethene	140.00	ug/L		5	28.00				319.91	0.44		No	Perf Monitoring
	11891	6/11/98	Trichloroethene	26.00	ug/L		5	5.20				407.56	0.06		No	Perf Monitoring
	11891	6/11/98	Uranium-233/234	2.50	pCi/L		1.07	2.33	60.7	0.04					No	Perf Monitoring
	11891	6/11/98	Uranium-238	1.41	pCi/L		0.768	1.84	41.8	0.03					No	Perf Monitoring
	11891	11/19/98	Carbon Tetrachloride	430.00	ug/L	D	5	86.00				737.11	0.58		No	Perf Monitoring
	11891	11/19/98	Tetrachloroethene	500.00	ug/L	D	5	100.00				319.91	1.56	Yes	No	Perf Monitoring
	11891	11/19/98	Trichloroethene	80.00	ug/L	D	5	16.00				407.56	0.20		No	Perf Monitoring
	11891	11/19/98	Uranium-233/234	2.59	pCi/L	B	1.07	2.42	60.7	0.04					No	Perf Monitoring
	11891	11/19/98	Uranium-238	1.71	pCi/L	B	0.768	2.23	41.8	0.04					No	Perf Monitoring
	12191	3/5/98	Carbon Tetrachloride	240.00	ug/L		5	48.00				435.97	0.55		No	Perf Monitoring
	12191	3/5/98	Tetrachloroethene	290.00	ug/L		5	58.00				486.46	0.60		No	Perf Monitoring
	12191	3/5/98	Trichloroethene	53.00	ug/L		5	10.60				67.86	0.78		No	Perf Monitoring
	12191	3/5/98	Uranium-233/234	2.36	pCi/L		1.07	2.21	60.7	0.04					No	Perf Monitoring
	12191	3/5/98	Uranium-238	1.49	pCi/L		0.768	1.94	41.8	0.04					No	Perf Monitoring
	12191	4/28/98	1,1-Dichloroethene	7.00	ug/L		7	1.00							No	Perf Monitoring
	12191	4/28/98	Carbon Tetrachloride	220.00	ug/L		5	44.00				435.97	0.50		No	Perf Monitoring
	12191	4/28/98	Tetrachloroethene	210.00	ug/L		5	42.00				486.46	0.43		No	Perf Monitoring
	12191	4/28/98	Trichloroethene	27.00	ug/L		5	5.40				67.86	0.40		No	Perf Monitoring
	12191	4/28/98	Uranium-233/234	1.85	pCi/L		1.07	1.73	60.7	0.03					No	Perf Monitoring
	12191	4/28/98	Uranium-238	1.30	pCi/L		0.768	1.69	41.8	0.03					No	Perf Monitoring
	12191	12/15/98	Carbon Tetrachloride	140.00	ug/L		5	28.00				435.97	0.32		No	Perf Monitoring
	12191	12/15/98	Tetrachloroethene	170.00	ug/L		5	34.00				486.46	0.35		No	Perf Monitoring
	12191	12/15/98	Trichloroethene	25.00	ug/L		5	5.00				67.86	0.37		No	Perf Monitoring

Table 2-8 1998 Groundwater Values Above Tier II Action Levels and Standard Framework Criteria (ALF) in RFCA - Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II	Tier II Ratio	Back-ground M2SD	Back-ground Ratio	Above Back-ground?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?	Well Class
Performance Monitoring	12191	12/15/98	Uranium-233/234	2.20	pCi/L		1.07	2.06	60.7	0.04					No	Perf Monitoring
	12191	12/15/98	Uranium-238	1.13	pCi/L		0.768	1.47	41.8	0.03					No	Perf Monitoring
	12691	2/26/98	Carbon Tetrachloride	480.00	ug/L		5	96.00				2968.95	0.16		No	Perf Monitoring
	12691	2/26/98	cis-1,2-Dichloroethene	70.00	ug/L		70	1.00				65.9	1.06	Yes	No	Perf Monitoring
	12691	2/26/98	Tetrachloroethene	140.00	ug/L		5	28.00				646.52	0.22		No	Perf Monitoring
	12691	2/26/98	Trichloroethene	68.00	ug/L		5	13.60				362.45	0.19		No	Perf Monitoring
	12691	2/26/98	Uranium-233/234	2.58	pCi/L		1.07	2.41	60.7	0.04					No	Perf Monitoring
	12691	2/26/98	Uranium-238	2.11	pCi/L		0.768	2.75	41.8	0.05					No	Perf Monitoring
	12691	8/5/98	Carbon Tetrachloride	370.00	ug/L	D	5	74.00				2968.95	0.12		No	Perf Monitoring
	12691	8/5/98	Methylene Chloride	21.00	ug/L	D	5	4.20							No	Perf Monitoring
	12691	8/5/98	Tetrachloroethene	68.00	ug/L	D	5	13.60				646.52	0.11		No	Perf Monitoring
	12691	8/5/98	Trichloroethene	49.00	ug/L	D	5	9.80				362.45	0.14		No	Perf Monitoring
	12691	8/5/98	Uranium-233/234	2.44	pCi/L		1.07	2.28	60.7	0.04					No	Perf Monitoring
	12691	8/5/98	Uranium-238	1.66	pCi/L		0.768	2.16	41.8	0.04					No	Perf Monitoring
	3687	3/10/98	1,1-Dichloroethene	16.00	ug/L		7	2.29				187	0.09		No	Perf Monitoring
	3687	3/10/98	Carbon Tetrachloride	430.00	ug/L		5	86.00				1255.4	0.34		No	Perf Monitoring
	3687	3/10/98	Tetrachloroethene	290.00	ug/L		5	58.00				814.46	0.36		No	Perf Monitoring
	3687	3/10/98	Trichloroethene	6000.00	ug/L		5	1200.00				993.25	6.04	Yes	No	Perf Monitoring
	3687	3/10/98	Uranium-233/234	1.68	pCi/L		1.07	1.57	60.7	0.03					No	Perf Monitoring
	3687	3/10/98	Uranium-238	0.81	pCi/L	J	0.768	1.06	41.8	0.02					No	Perf Monitoring
	3687	5/26/98	1,1-Dichloroethene	53.00	ug/L	E	7	7.57				187	0.28		No	Perf Monitoring
	3687	5/26/98	Carbon Tetrachloride	250.00	ug/L	E	5	50.00				1255.4	0.20		No	Perf Monitoring
	3687	5/26/98	Chloroform	510.00	ug/L	E	100	5.10							No	Perf Monitoring
	3687	5/26/98	Methylene Chloride	1600.00	ug/L	JDB	5	320.00							No	Perf Monitoring
	3687	5/26/98	Tetrachloroethene	460.00	ug/L	JD	5	92.00				814.46	0.56		No	Perf Monitoring
	3687	5/26/98	Trichloroethene	6300.00	ug/L	D	5	1260.00				993.25	6.34	Yes	No	Perf Monitoring
	3687	5/26/98	Uranium-233/234	1.37	pCi/L		1.07	1.28	60.7	0.02					No	Perf Monitoring
	3687	5/26/98	Uranium-238	0.81	pCi/L	J	0.768	1.06	41.8	0.02					No	Perf Monitoring
	3687	10/26/98	1,1-Dichloroethene	120.00	ug/L	E	7	17.14				187	0.64		No	Perf Monitoring
	3687	10/26/98	Carbon Tetrachloride	640.00	ug/L	E	5	128.00				1255.4	0.51		No	Perf Monitoring
	3687	10/26/98	Chloroform	4700.00	ug/L	D	100	47.00							No	Perf Monitoring
	3687	10/26/98	Methylene Chloride	11.00	ug/L		5	2.20							No	Perf Monitoring
	3687	10/26/98	Tetrachloroethene	780.00	ug/L	E	5	156.00				814.46	0.96		No	Perf Monitoring
	3687	10/26/98	Trichloroethene	53000.00	ug/L	D	5	10600.00				993.25	53.36	Yes	No	Perf Monitoring
	3687	10/26/98	Uranium-233/234	1.52	pCi/L	B	1.07	1.42	60.7	0.03					No	Perf Monitoring
	3687	10/26/98	Uranium-238	0.87	pCi/L	J	0.768	1.14	41.8	0.02					No	Perf Monitoring
	891COLGAL	6/10/98	Uranium-233/234	5.10	pCi/L		1.07	4.76	60.7	0.08					No	Perf Monitoring
	891COLGAL	6/10/98	Uranium-238	3.99	pCi/L		0.768	5.20	41.8	0.10					No	Perf Monitoring
	891COLGAL	8/20/98	Uranium-233/234	6.25	pCi/L		1.07	5.84	60.7	0.10					No	Perf Monitoring
	891COLGAL	8/20/98	Uranium-238	5.17	pCi/L		0.768	6.73	41.8	0.12					No	Perf Monitoring
	891COLGAL	11/4/98	Uranium-233/234	6.54	pCi/L		1.07	6.11	60.7	0.11					No	Perf Monitoring
	891COLGAL	11/4/98	Uranium-238	4.34	pCi/L		0.768	5.65	41.8	0.10					No	Perf Monitoring
	891COLWEL	6/10/98	Carbon Tetrachloride	21.00	ug/L		5	4.20							No	Perf Monitoring
	891COLWEL	6/10/98	Methylene Chloride	190.00	ug/L	DB	5	38.00							No	Perf Monitoring
	891COLWEL	6/10/98	Selenium	620.00	ug/L		50	12.40	43.72	14.18	Yes				No	Perf Monitoring
	891COLWEL	6/10/98	Tetrachloroethene	29.00	ug/L		5	5.80							No	Perf Monitoring
	891COLWEL	6/10/98	Trichloroethene	230.00	ug/L	D	5	46.00							No	Perf Monitoring
	891COLWEL	6/10/98	Uranium-233/234	10.89	pCi/L		1.07	10.17	60.7	0.18					No	Perf Monitoring
	891COLWEL	6/10/98	Uranium-238	7.97	pCi/L		0.768	10.38	41.8	0.19					No	Perf Monitoring
	891COLWEL	8/20/98	Carbon Tetrachloride	12.00	ug/L		5	2.40							No	Perf Monitoring
	891COLWEL	8/20/98	Methylene Chloride	15.00	ug/L	D	5	3.00							No	Perf Monitoring
	891COLWEL	8/20/98	Selenium	470.00	ug/L	N	50	9.40	43.72	10.75	Yes				No	Perf Monitoring
	891COLWEL	8/20/98	Tetrachloroethene	13.00	ug/L		5	2.60							No	Perf Monitoring
	891COLWEL	8/20/98	Trichloroethene	100.00	ug/L	D	5	20.00							No	Perf Monitoring
	891COLWEL	8/20/98	Uranium-233/234	11.70	pCi/L		1.07	10.93	60.7	0.19					No	Perf Monitoring
	891COLWEL	8/20/98	Uranium-238	8.59	pCi/L		0.768	11.18	41.8	0.21					No	Perf Monitoring
	891COLWEL	11/2/98	Carbon Tetrachloride	6.00	ug/L		5	1.20							No	Perf Monitoring
	891COLWEL	11/2/98	Methylene Chloride	380.00	ug/L	BD	5	76.00							No	Perf Monitoring
	891COLWEL	11/2/98	Selenium	480.00	ug/L	*	50	9.60	43.72	10.98	Yes				No	Perf Monitoring
	891COLWEL	11/2/98	Tetrachloroethene	40.00	ug/L	D	5	8.00							No	Perf Monitoring
	891COLWEL	11/2/98	Trichloroethene	280.00	ug/L	D	5	56.00							No	Perf Monitoring
	891COLWEL	11/2/98	Uranium-233/234	10.40	pCi/L		1.07	9.72	60.7	0.17					No	Perf Monitoring
	891COLWEL	11/2/98	Uranium-238	7.83	pCi/L		0.768	10.20	41.8	0.19					No	Perf Monitoring
	SW059	6/4/98	Carbon Tetrachloride	150.00	ug/L	D	5	30.00							No	Perf Monitoring
	SW059	6/4/98	Methylene Chloride	8.00	ug/L	BJD	5	1.60							No	Perf Monitoring
	SW059	6/4/98	Tetrachloroethene	48.00	ug/L	D	5	9.60							No	Perf Monitoring
	SW059	6/4/98	Trichloroethene	58.00	ug/L	D	5	11.60							No	Perf Monitoring
	SW059	6/4/98	Uranium-233/234	4.02	pCi/L		1.07	3.75	60.7	0.07					No	Perf Monitoring
	SW059	6/4/98	Uranium-238	3.01	pCi/L		0.768	3.93	41.8	0.07					No	Perf Monitoring
	SW13494	6/19/98	Tetrachloroethene	35.00	ug/L		5	7.00							No	Perf Monitoring
	SW13494	6/19/98	Uranium-233/234	4.08	pCi/L		1.07	3.82	60.7	0.07					No	Perf Monitoring
	SW13494	6/19/98	Uranium-238	2.71	pCi/L		0.768	3.53	41.8	0.06					No	Perf Monitoring
	SW13494	8/19/98	Tetrachloroethene	18.00	ug/L		5	3.60							No	Perf Monitoring
	SW13494	8/19/98	Uranium-233/234	4.71	pCi/L		1.07	4.40	60.7	0.08					No	Perf Monitoring
	SW13494	8/19/98	Uranium-238	3.88	pCi/L		0.768	5.05	41.8	0.09					No	Perf Monitoring
	SW13494	11/2/98	Methylene Chloride	5.00	ug/L	B	5	1.00							No	Perf Monitoring
	SW13494	11/2/98	Tetrachloroethene	40.00	ug/L		5	8.00							No	Perf Monitoring
	SW13494	11/2/98	Uranium-233/234	3.15	pCi/L		1.07	2.94	60.7	0.05					No	Perf Monitoring
	SW13494	11/2/98	Uranium-238	2.28	pCi/L		0.768	2.97	41.8	0.05					No	Perf Monitoring

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Table 2-8 1998 Groundwater Values Above Tier II Action Levels and Standard Framework Criteria (ALF) in RFCA - Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II	Tier II Ratio	Back-ground M2SD	Back-ground Ratio	Above Back-ground?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?	Well Class
Plume Definition	00491	7/13/98	Carbon Tetrachloride	160.00	ug/L		5	32.00				545	0.29		No	Plume Definition
	00491	7/13/98	Tetrachloroethene	18.00	ug/L		5	3.60				54	0.33		No	Plume Definition
	00491	7/13/98	Trichloroethene	43.00	ug/L		5	8.60				153	0.28		No	Plume Definition
	00491	7/13/98	Uranium-233/234	10.12	pCi/L		1.07	9.46	60.7	0.17					No	Plume Definition
	00491	7/13/98	Uranium-238	5.14	pCi/L		0.768	6.70	41.8	0.12					No	Plume Definition
	00491	9/28/98	Carbon Tetrachloride	200.00	ug/L	D	5	40.00				545	0.37		No	Plume Definition
	00491	9/28/98	Methylene Chloride	6.00	ug/L	D	5	1.20							No	Plume Definition
	00491	9/28/98	Tetrachloroethene	37.00	ug/L	D	5	7.40				54	0.69		No	Plume Definition
	00491	9/28/98	Trichloroethene	82.00	ug/L	D	5	16.40				153	0.54		No	Plume Definition
	00597	3/3/98	1,1-Dichloroethene	9.00	ug/L		7	1.29							No	Plume Definition
	00597	3/3/98	Nitrate/Nitrite	10.10	mg/L		10	1.01	4.664	2.17	Yes				No	Plume Definition
	00597	3/3/98	Trichloroethene	6.00	ug/L		5	1.20							No	Plume Definition
	00597	7/28/98	1,1-Dichloroethene	13.00	ug/L		7	1.86							No	Plume Definition
	00597	7/28/98	Nitrate/Nitrite	10.00	mg/L		10	1.00	4.664	2.14	Yes				No	Plume Definition
	00597	7/28/98	Trichloroethene	6.00	ug/L		5	1.20							No	Plume Definition
	0487	3/4/98	Selenium	125.00	ug/L		50	2.50	43.72	2.86	Yes	699.76	0.18		No	Plume Definition
	0487	3/4/98	Trichloroethene	66.00	ug/L		5	13.20				5685.56	0.01		No	Plume Definition
	0487	3/4/98	Uranium-233/234	16.00	pCi/L		1.07	14.95	60.7	0.26					No	Plume Definition
	0487	3/4/98	Uranium-238	12.90	pCi/L		0.768	16.80	41.8	0.31					No	Plume Definition
	0487	7/29/98	Methylene Chloride	8.00	ug/L	DB	5	1.60							No	Plume Definition
	0487	7/29/98	Selenium	86.90	ug/L		50	1.74	43.72	1.99	Yes	699.76	0.12		No	Plume Definition
	0487	7/29/98	Trichloroethene	63.00	ug/L	D	5	12.60				5685.56	0.01		No	Plume Definition
	0487	7/29/98	Uranium-233/234	16.52	pCi/L		1.07	15.44	60.7	0.27					No	Plume Definition
	0487	7/29/98	Uranium-238	13.39	pCi/L		0.768	17.44	41.8	0.32					No	Plume Definition
	05391	2/18/98	Carbon Tetrachloride	13.00	ug/L		5	2.60				32.88	0.40		No	Plume Definition
	05391	2/18/98	Uranium-233/234	2.70	pCi/L		1.07	2.52	60.7	0.04					No	Plume Definition
	05391	2/18/98	Uranium-238	0.92	pCi/L		0.768	1.20	41.8	0.02					No	Plume Definition
	05391	7/7/98	Uranium-233/234	1.64	pCi/L		1.07	1.53	60.7	0.03					No	Plume Definition
	05391	7/7/98	Uranium-238	1.24	pCi/L		0.768	1.62	41.8	0.03					No	Plume Definition
	2987	6/2/98	Nickel	1770.00	ug/L		100	17.70	21.37	82.83	Yes	1742	1.02	Yes	No	Plume Definition
	2987	6/2/98	Selenium	361.00	ug/L		50	7.22	43.72	8.26	Yes	406	0.89		No	Plume Definition
	2987	6/2/98	Uranium-233/234	11.76	pCi/L		1.07	10.99	60.7	0.19					No	Plume Definition
	2987	6/2/98	Uranium-238	8.67	pCi/L		0.768	11.28	41.8	0.21					No	Plume Definition
	2987	10/22/98	Nickel	955.00	ug/L		100	9.55	21.37	44.69	Yes	1742	0.55		No	Plume Definition
	2987	10/22/98	Selenium	251.00	ug/L		50	5.02	43.72	5.74	Yes	406	0.62		No	Plume Definition
	2987	10/22/98	Sulfate	830.00	mg/L		500	1.66	435.6	1.91	Yes				No	Plume Definition
	2987	10/22/98	Uranium-233/234	12.70	pCi/L		1.07	11.87	60.7	0.21					No	Plume Definition
	2987	10/22/98	Uranium-238	9.30	pCi/L		0.768	12.11	41.8	0.22					No	Plume Definition
	3087	5/21/98	Uranium-233/234	1.17	pCi/L		1.07	1.09	60.7	0.02					No	Plume Definition
	3087	10/28/98	Trichloroethene	5.00	ug/L		5	1.00							No	Plume Definition
	6286	2/24/98	Carbon Tetrachloride	8.00	ug/L		5	1.60				9.76	0.82		No	Plume Definition
	6286	2/24/98	Selenium	60.90	ug/L		50	1.22	43.72	1.39	Yes	65.96	0.92		No	Plume Definition
	6286	2/25/98	Uranium-233/234	4.70	pCi/L		1.07	4.39	60.7	0.08					No	Plume Definition
	6286	2/25/98	Uranium-238	3.91	pCi/L		0.768	5.09	41.8	0.09					No	Plume Definition
	6286	7/8/98	Carbon Tetrachloride	6.00	ug/L		5	1.20				9.76	0.61		No	Plume Definition
	6286	7/8/98	Uranium-233/234	3.23	pCi/L		1.07	3.01	60.7	0.05					No	Plume Definition
	6286	7/8/98	Uranium-238	2.79	pCi/L		0.768	3.64	41.8	0.07					No	Plume Definition
	6386	7/14/98	Uranium-233/234	8.60	pCi/L		1.07	8.04	60.7	0.14					No	Plume Definition
	6386	7/14/98	Uranium-238	6.71	pCi/L		0.768	8.73	41.8	0.16					No	Plume Definition
	6386	9/28/98	Methylene Chloride	8.00	ug/L		5	1.60							No	Plume Definition
	77392	6/9/98	Uranium-233/234	21.73	pCi/L		1.07	20.31	60.7	0.36					No	Plume Definition
	77392	6/9/98	Uranium-238	12.34	pCi/L		0.768	16.06	41.8	0.30					No	Plume Definition
	77392	6/10/98	Fluoride	5.10	mg/L		4	1.28	1.55	3.29	Yes				No	Plume Definition
	P209389	2/18/98	1,1-Dichloroethene	29.00	ug/L	D	7	4.14				88.48	0.33		No	Plume Definition
	P209489	5/13/98	Carbon Tetrachloride	52.00	ug/L	D	5	10.40				83.26	0.62		No	Plume Definition
	P209489	5/13/98	Methylene Chloride	6.00	ug/L	D	5	1.20							No	Plume Definition
	P209489	5/13/98	Trichloroethene	63.00	ug/L	D	5	12.60				90.4	0.70		No	Plume Definition
	P209489	5/14/98	Nitrate/Nitrite	120.00	mg/L	N	10	12.00	4.664	25.73	Yes	316.24	0.38		No	Plume Definition
	P209489	5/14/98	Uranium-233/234	13.34	pCi/L		1.07	12.47	60.7	0.22					No	Plume Definition
	P209489	5/14/98	Uranium-235	1.18	pCi/L		1.01	1.17	1.79	0.66					No	Plume Definition
	P209489	5/14/98	Uranium-238	12.38	pCi/L		0.768	16.11	41.8	0.30					No	Plume Definition
	P209489	12/16/98	Nitrate/Nitrite	180.00	mg/L		10	18.00	4.664	38.59	Yes	316.24	0.57		No	Plume Definition
	P209489	12/16/98	Uranium-233/234	18.10	pCi/L		1.07	16.92	60.7	0.30					No	Plume Definition
	P209489	12/16/98	Uranium-238	15.10	pCi/L		0.768	19.66	41.8	0.36					No	Plume Definition
	P219189	1/6/98	1,1-Dichloroethene	17.00	ug/L		7	2.43				46.76	0.36		No	Plume Definition
	P219189	6/16/98	1,1-Dichloroethene	30.00	ug/L		7	4.29				46.76	0.64		No	Plume Definition
	P219189	6/16/98	Carbon Tetrachloride	7.00	ug/L		5	1.40							No	Plume Definition
	P219189	6/16/98	Uranium-233/234	56.15	pCi/L		1.07	52.48	60.7	0.93					No	Plume Definition
	P219189	6/16/98	Uranium-235	3.14	pCi/L		1.01	3.11	1.79	1.76	Yes				No	Plume Definition
	P219189	6/16/98	Uranium-238	43.87	pCi/L		0.768	57.12	41.8	1.05	Yes				No	Plume Definition
	P219189	11/3/98	1,1-Dichloroethene	18.00	ug/L		7	2.57				46.76	0.38		No	Plume Definition
	P416789	3/24/98	Tetrachloroethene	5.00	ug/L		5	1.00				7.63	0.66		No	Plume Definition
	P416789	3/24/98	Trichloroethene	10.00	ug/L		5	2.00				26.19	0.38		No	Plume Definition
	P416889	3/9/98	Tetrachloroethene	6.00	ug/L		5	1.20				77.7	0.08		No	Plume Definition
	P416889	6/2/98	Tetrachloroethene	30.00	ug/L		5	6.00				77.7	0.39		No	Plume Definition
	P416889	10/28/98	Tetrachloroethene	29.00	ug/L		5	5.80				77.7	0.37		No	Plume Definition
	P416889	10/28/98	Uranium-233/234	1.30	pCi/L	B	1.07	1.21	60.7	0.02					No	Plume Definition

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Table 2-8 1998 Groundwater Values Above Tier II Action Levels and Standard Framework Criteria (ALF) in RFCA - Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II	Tier II Ratio	Back-ground M2SD	Back-ground Ratio	Above Back-ground?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?	Well Class
Plume Extent	03991	8/6/98	Carbon Tetrachloride	41.00	ug/L	D	5	8.20				27.22	1.51	Yes	Yes	Plume Extent
	03991	8/6/98	Tetrachloroethene	11.00	ug/L		5	2.20				6.38	1.72	Yes	Yes	Plume Extent
	03991	8/6/98	Trichloroethene	6.00	ug/L		5	1.20				19.03	0.32		No	Plume Extent
	03991	8/6/98	Uranium-233/234	2.09	pCi/L		1.07	1.95	60.7	0.03					No	Plume Extent
	03991	8/6/98	Uranium-238	1.38	pCi/L		0.768	1.80	41.8	0.03					No	Plume Extent
	04091	2/25/98	Uranium-233/234	2.48	pCi/L		1.07	2.32	60.7	0.04					No	Plume Extent
	04091	2/25/98	Uranium-238	1.52	pCi/L		0.768	1.98	41.8	0.04					No	Plume Extent
	04091	5/27/98	Uranium-233/234	2.24	pCi/L		1.07	2.10	60.7	0.04					No	Plume Extent
	04091	5/27/98	Uranium-238	1.49	pCi/L		0.768	1.94	41.8	0.04					No	Plume Extent
	04091	10/19/98	Uranium-233/234	2.29	pCi/L		1.07	2.14	60.7	0.04					No	Plume Extent
	04091	10/19/98	Uranium-238	1.19	pCi/L		0.768	1.55	41.8	0.03					No	Plume Extent
	04591	3/13/98	Uranium-233/234	2.98	pCi/L		1.07	2.79	60.7	0.05					No	Plume Extent
	04591	3/13/98	Uranium-238	1.38	pCi/L		0.768	1.80	41.8	0.03					No	Plume Extent
	04591	8/24/98	Uranium-233/234	2.15	pCi/L		1.07	2.01	60.7	0.04					No	Plume Extent
	04591	8/24/98	Uranium-238	1.11	pCi/L		0.768	1.45	41.8	0.03					No	Plume Extent
	04991	2/24/98	Uranium-233/234	5.84	pCi/L		1.07	5.46	60.7	0.10					No	Plume Extent
	04991	2/24/98	Uranium-238	3.54	pCi/L		0.768	4.61	41.8	0.08					No	Plume Extent
	04991	6/9/98	Methylene Chloride	5.00	ug/L	B	5	1.00							No	Plume Extent
	04991	6/9/98	Uranium-233/234	5.09	pCi/L		1.07	4.75	60.7	0.08					No	Plume Extent
	04991	6/9/98	Uranium-238	2.86	pCi/L		0.768	3.72	41.8	0.07					No	Plume Extent
	04991	10/27/98	Methylene Chloride	6.00	ug/L		5	1.20							No	Plume Extent
	04991	10/27/98	Trichloroethene	6.00	ug/L		5	1.20							Yes	Plume Extent
	04991	10/27/98	Uranium-233/234	6.42	pCi/L	B	1.07	6.00	60.7	0.11					No	Plume Extent
	04991	10/27/98	Uranium-238	4.27	pCi/L	B	0.768	5.56	41.8	0.10					No	Plume Extent
	05091	2/27/98	Uranium-233/234	4.38	pCi/L		1.07	4.09	60.7	0.07					No	Plume Extent
	05091	2/27/98	Uranium-238	2.39	pCi/L		0.768	3.11	41.8	0.06					No	Plume Extent
	05091	8/26/98	Uranium-233/234	5.06	pCi/L		1.07	4.73	60.7	0.08					No	Plume Extent
	05091	8/26/98	Uranium-238	3.06	pCi/L		0.768	3.98	41.8	0.07					No	Plume Extent
	06091	3/4/98	Carbon Tetrachloride	5.00	ug/L		5	1.00				4.44	1.13	Yes	No	Plume Extent
	06091	3/4/98	Uranium-233/234	4.00	pCi/L		1.07	3.74	60.7	0.07					No	Plume Extent
	06091	3/4/98	Uranium-238	2.82	pCi/L		0.768	3.67	41.8	0.07					No	Plume Extent
	06091	4/23/98	Uranium-233/234	2.09	pCi/L		1.07	1.95	60.7	0.03					No	Plume Extent
	06091	4/23/98	Uranium-238	1.25	pCi/L		0.768	1.63	41.8	0.03					No	Plume Extent
	06091	10/29/98	Carbon Tetrachloride	6.00	ug/L		5	1.20				4.44	1.35	Yes	No	Plume Extent
	06091	10/29/98	Methylene Chloride	17.00	ug/L		5	3.40							Yes	Plume Extent
	06091	10/29/98	Nitrate/Nitrite	12.00	mg/L		10	1.20	4.664	2.57	Yes				Yes	Plume Extent
	06091	10/29/98	Uranium-233/234	3.39	pCi/L	B	1.07	3.17	60.7	0.06					No	Plume Extent
	06091	10/29/98	Uranium-238	2.16	pCi/L	B	0.768	2.81	41.8	0.05					No	Plume Extent
	08091	6/17/98	Uranium-233/234	7.88	pCi/L		1.07	7.37	60.7	0.13					No	Plume Extent
	08091	6/17/98	Uranium-238	3.19	pCi/L		0.768	4.15	41.8	0.08					No	Plume Extent
	10194	3/4/98	Uranium-233/234	2.46	pCi/L		1.07	2.30	60.7	0.04					No	Plume Extent
	10194	3/4/98	Uranium-238	1.25	pCi/L		0.768	1.63	41.8	0.03					No	Plume Extent
	10194	7/20/98	Uranium-233/234	2.26	pCi/L		1.07	2.11	60.7	0.04					No	Plume Extent
	10194	7/20/98	Uranium-238	1.58	pCi/L		0.768	2.06	41.8	0.04					No	Plume Extent
	10994	7/14/98	Selenium	285.00	ug/L		50	5.70	43.72	6.52	Yes	1097.2	0.26		No	Plume Extent
	10994	7/14/98	Uranium-233/234	7.52	pCi/L		1.07	7.02	60.7	0.12					No	Plume Extent
	10994	7/14/98	Uranium-238	5.03	pCi/L		0.768	6.55	41.8	0.12					No	Plume Extent
	1386	5/27/98	Nickel	326.00	ug/L		100	3.26	21.37	15.26	Yes	308.75	1.06	Yes	Yes	Plume Extent
	1386	5/27/98	Strontium-89/90	1.17	pCi/L		0.852	1.37	2.85	0.41					No	Plume Extent
	1386	5/27/98	Uranium-233/234	8.94	pCi/L		1.07	8.35	60.7	0.15					No	Plume Extent
	1386	5/27/98	Uranium-238	7.08	pCi/L		0.768	9.22	41.8	0.17					No	Plume Extent
	1386	6/19/98	Nickel	305.00	ug/L		100	3.05	21.37	14.27	Yes	308.75	0.99		No	Plume Extent
	1386	7/15/98	Nickel	521.00	ug/L		100	5.21	21.37	24.38	Yes	308.75	1.69	Yes	Yes	Plume Extent
	1386	8/19/98	Nickel	979.00	ug/L		100	9.79	21.37	45.81	Yes	308.75	3.17	Yes	Yes	Plume Extent
	1386	10/14/98	Nickel	904.00	ug/L		100	9.04	21.37	42.30	Yes	308.75	2.93	Yes	Yes	Plume Extent
	1386	10/14/98	Uranium-233/234	7.01	pCi/L		1.07	6.55	60.7	0.12					No	Plume Extent
	1386	10/14/98	Uranium-238	6.90	pCi/L		0.768	8.98	41.8	0.17					No	Plume Extent
	1786	4/23/98	Nitrate/Nitrite	510.00	mg/L		10	51.00	4.664	109.35	Yes	689.31	0.74		No	Plume Extent
	1786	4/23/98	Selenium	126.00	ug/L		50	2.52	43.72	2.88	Yes	290.81	0.43		No	Plume Extent
	1786	4/23/98	Uranium-233/234	40.74	pCi/L		1.07	38.08	60.7	0.67					No	Plume Extent
	1786	4/23/98	Uranium-235	1.46	pCi/L		1.01	1.45	1.79	0.82					No	Plume Extent
	1786	4/23/98	Uranium-238	28.67	pCi/L		0.768	37.33	41.8	0.69					No	Plume Extent
	1786	10/28/98	Nitrate/Nitrite	570.00	mg/L		10	57.00	4.664	122.21	Yes	689.31	0.83		No	Plume Extent
	1786	10/28/98	Selenium	169.00	ug/L		50	3.38	43.72	3.87	Yes	290.81	0.58		No	Plume Extent
	1786	10/28/98	Trichloroethene	6.00	ug/L		5	1.20							No	Plume Extent
	1786	10/28/98	Uranium-233/234	33.20	pCi/L		1.07	31.03	60.7	0.55					No	Plume Extent
	1786	10/28/98	Uranium-238	26.60	pCi/L	B	0.768	34.64	41.8	0.64					No	Plume Extent
	1986	3/23/98	Manganese	2050.00	ug/L		183	11.20	162.33	12.63	Yes	3304	0.62		No	Plume Extent
	1986	6/17/98	Manganese	3690.00	ug/L	*	183	20.16	162.33	22.73	Yes	3304	1.12	Yes	Yes	Plume Extent
	1986	10/27/98	Manganese	2610.00	ug/L		183	14.26	162.33	16.08	Yes	3304	0.79		No	Plume Extent
	1986	10/27/98	Trichloroethene	28.00	ug/L		5	5.60							No	Plume Extent
	1986	10/27/98	Uranium-233/234	2.44	pCi/L	B	1.07	2.28	60.7	0.04					No	Plume Extent
	1986	10/27/98	Uranium-238	2.02	pCi/L	B	0.768	2.63	41.8	0.05					No	Plume Extent
	1986	11/23/98	Manganese	2590.00	ug/L		183	14.15	162.33	15.96	Yes	3304	0.78		No	Plume Extent
	1986	12/16/98	Manganese	2330.00	ug/L	*	183	12.73	162.33	14.35	Yes	3304	0.71		No	Plume Extent
	2186	12/2/98	Uranium-233/234	1.42	pCi/L		1.07	1.33	60.7	0.02					No	Plume Extent
	2186	12/2/98	Uranium-238	1.04	pCi/L	B	0.768	1.35	41.8	0.02					No	Plume Extent
	22696	8/31/98	Trichloroethene	10.00	ug/L		5	2.00							No	Plume Extent

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Table 2-8 1998 Groundwater Values Above Tier II Action Levels and Standard Framework Criteria (ALF) in RFCA - Designated Wells

Well Class	Location	Sample Date	Analyte	Result	Units	Q	Tier II	Tier II Ratio	Back-ground M2SD	Back-ground Ratio	Above Back-ground?	Historic M2SD	Historic Ratio	Above Historic?	Reportable?	Well Class
Plume Extent	22796	6/16/98	Manganese	1150.00	ug/L	*	183	6.28	162.33	7.08	Yes				No	Plume Extent
	22796	6/16/98	Trichloroethene	29.00	ug/L		5	5.80							No	Plume Extent
	22796	12/1/98	Manganese	391.00	ug/L		183	2.14	162.33	2.41	Yes				No	Plume Extent
	22796	12/1/98	Uranium-233/234	3.03	pCi/L		1.07	2.83	60.7	0.05					No	Plume Extent
	22796	12/1/98	Uranium-238	1.89	pCi/L	B	0.768	2.46	41.8	0.05					No	Plume Extent
	22896	3/23/98	Manganese	361.00	ug/L		183	1.97	162.33	2.22	Yes				No	Plume Extent
	22896	3/23/98	Nickel	1050.00	ug/L		100	10.50	21.37	49.13	Yes				No	Plume Extent
	22896	3/23/98	Trichloroethene	3400.00	ug/L		5	680.00							No	Plume Extent
	22896	9/1/98	Chromium	248.00	ug/L		100	2.48	12.44	19.94	Yes				No	Plume Extent
	22896	9/1/98	Trichloroethene	2400.00	ug/L	D	5	480.00							No	Plume Extent
	23096	2/26/98	Uranium-233/234	1.90	pCi/L		1.07	1.78	60.7	0.03					No	Plume Extent
	23096	2/26/98	Uranium-238	2.85	pCi/L		0.768	3.71	41.8	0.07					No	Plume Extent
	23096	8/17/98	Uranium-233/234	2.55	pCi/L		1.07	2.38	60.7	0.04					No	Plume Extent
	23096	8/17/98	Uranium-238	2.97	pCi/L		0.768	3.87	41.8	0.07					No	Plume Extent
	23196	2/25/98	Nitrate/Nitrite	10.20	mg/L		10	1.02	4.664	2.19	Yes				Yes	Plume Extent
	23296	3/24/98	Carbon Tetrachloride	13.00	ug/L		5	2.60							No	Plume Extent
	23296	3/24/98	cis-1,2-Dichloroethene	78.00	ug/L		70	1.11							No	Plume Extent
	23296	3/24/98	Tetrachloroethene	17.00	ug/L		5	3.40							No	Plume Extent
	23296	3/24/98	Trichloroethene	690.00	ug/L		5	138.00							No	Plume Extent
	23296	3/24/98	Uranium-233/234	18.30	pCi/L		1.07	17.10	60.7	0.30					No	Plume Extent
	23296	3/24/98	Uranium-238	13.10	pCi/L		0.768	17.06	41.8	0.31					No	Plume Extent
	23296	8/31/98	cis-1,2-Dichloroethene	100.00	ug/L	E	70	1.43							No	Plume Extent
	23296	8/31/98	Manganese	327.00	ug/L		183	1.79	162.33	2.01	Yes				Yes	Plume Extent
	23296	8/31/98	Tetrachloroethene	10.00	ug/L		5	2.00							No	Plume Extent
	23296	8/31/98	Trichloroethene	280.00	ug/L	D	5	56.00							No	Plume Extent
	23296	8/31/98	Uranium-233/234	11.50	pCi/L		1.07	10.75	60.7	0.19					No	Plume Extent
	23296	8/31/98	Uranium-238	8.47	pCi/L		0.768	11.03	41.8	0.20					No	Plume Extent
	3586	3/16/98	Uranium-233/234	3.01	pCi/L		1.07	2.81	60.7	0.05					No	Plume Extent
	3586	3/16/98	Uranium-238	2.73	pCi/L		0.768	3.55	41.8	0.07					No	Plume Extent
	3586	6/5/98	Manganese	4180.00	ug/L		183	22.84	162.33	25.75	Yes	4357	0.96		No	Plume Extent
	3586	6/5/98	Uranium-233/234	2.27	pCi/L		1.07	2.13	60.7	0.04					No	Plume Extent
	3586	6/5/98	Uranium-238	1.62	pCi/L		0.768	2.11	41.8	0.04					No	Plume Extent
	3586	6/5/98	Vinyl Chloride	14.00	ug/L		2	7.00				776	0.02		No	Plume Extent
	3586	10/20/98	Manganese	4270.00	ug/L		183	23.33	162.33	26.30	Yes	4357	0.98		No	Plume Extent
	3586	10/20/98	Uranium-233/234	2.44	pCi/L		1.07	2.28	60.7	0.04					No	Plume Extent
	3586	10/20/98	Uranium-238	2.02	pCi/L		0.768	2.63	41.8	0.05					No	Plume Extent
	3586	10/20/98	Vinyl Chloride	39.00	ug/L		2	19.50				776	0.05		No	Plume Extent
	5387	2/26/98	Uranium-233/234	9.52	pCi/L		1.07	8.90	60.7	0.16					No	Plume Extent
	5387	2/26/98	Uranium-238	8.03	pCi/L		0.768	10.46	41.8	0.19					No	Plume Extent
	5387	6/2/98	Uranium-233/234	11.26	pCi/L		1.07	10.53	60.7	0.19					No	Plume Extent
	5387	6/2/98	Uranium-238	7.30	pCi/L		0.768	9.50	41.8	0.17					No	Plume Extent
	5387	11/17/98	Methylene Chloride	8.00	ug/L		5	1.60							Yes	Plume Extent
	7086	2/27/98	Manganese	326.00	ug/L		183	1.78	162.33	2.01	Yes	761	0.43		No	Plume Extent
	7086	2/27/98	Uranium-233/234	1.10	pCi/L		1.07	1.03	60.7	0.02					No	Plume Extent
	7086	2/27/98	Uranium-238	0.88	pCi/L		0.768	1.15	41.8	0.02					No	Plume Extent
	7086	7/28/98	Manganese	309.00	ug/L		183	1.69	162.33	1.90	Yes	761	0.41		No	Plume Extent
	75992	7/7/98	Methylene Chloride	10.00	ug/L	B	5	2.00							No	Plume Extent
	75992	7/7/98	Strontium-89/90	1.02	pCi/L		0.852	1.20	2.85	0.36					No	Plume Extent
	75992	7/7/98	Uranium-233/234	10.46	pCi/L		1.07	9.78	60.7	0.17					No	Plume Extent
	75992	7/7/98	Uranium-238	8.17	pCi/L		0.768	10.64	41.8	0.20					No	Plume Extent
	B208289	2/24/98	Nitrate/Nitrite	47.70	mg/L		10	4.77	4.664	10.23	Yes	60.44	0.79		No	Plume Extent
	B208289	6/3/98	Nitrate/Nitrite	27.00	mg/L		10	2.70	4.664	5.79	Yes	60.44	0.45		No	Plume Extent
	B208289	6/3/98	Selenium	2880.00	ug/L		50	57.60	43.72	65.87	Yes				Yes	Plume Extent
	B208289	11/16/98	Selenium	3220.00	ug/L		50	64.40	43.72	73.65	Yes				Yes	Plume Extent
	B208789	5/27/98	Manganese	454.00	ug/L		183	2.48	162.33	2.80	Yes	624.21	0.73		No	Plume Extent
	B208789	5/27/98	Uranium-233/234	14.33	pCi/L		1.07	13.39	60.7	0.24					No	Plume Extent
	B208789	5/27/98	Uranium-238	11.44	pCi/L		0.768	14.90	41.8	0.27					No	Plume Extent
	B208789	11/19/98	Manganese	622.00	ug/L		183	3.40	162.33	3.83	Yes	624.21	1.00	Yes	Yes	Plume Extent
	B208789	11/19/98	Uranium-233/234	10.70	pCi/L	B	1.07	10.00	60.7	0.18					No	Plume Extent
	B208789	11/19/98	Uranium-238	8.06	pCi/L	B	0.768	10.49	41.8	0.19					No	Plume Extent
	P114389	6/19/98	Manganese	568.00	ug/L		183	3.10	162.33	3.50	Yes	663.52	0.86		No	Plume Extent
	P114389	7/21/98	Manganese	549.00	ug/L		183	3.00	162.33	3.38	Yes	663.52	0.83		No	Plume Extent
	P114389	8/18/98	Manganese	711.00	ug/L		183	3.89	162.33	4.38	Yes	663.52	1.07	Yes	Yes	Plume Extent
	P218389	1/20/98	Nitrate/Nitrite	10.00	mg/L		10	1.00	4.664	2.14	Yes				No	Plume Extent
	P218389	6/16/98	Uranium-233/234	1.98	pCi/L		1.07	1.85	60.7	0.03					No	Plume Extent
	P218389	6/16/98	Uranium-238	1.55	pCi/L		0.768	2.02	41.8	0.04					No	Plume Extent
	P219489	1/7/98	Nitrate/Nitrite	42.00	mg/L		10	4.20	4.664	9.01	Yes	38	1.11	Yes	No	Plume Extent
	P219489	6/10/98	Uranium-233/234	5.67	pCi/L		1.07	5.30	60.7	0.09					No	Plume Extent
	P219489	6/10/98	Uranium-238	3.88	pCi/L		0.768	5.05	41.8	0.09					No	Plume Extent
	P219489	11/3/98	Methylene Chloride	6.00	ug/L	B	5	1.20							No	Plume Extent
	P219489	11/3/98	Nitrate/Nitrite	47.00	mg/L		10	4.70	4.664	10.08	Yes	38	1.24	Yes	No	Plume Extent
	P314289	7/21/98	Manganese	330.00	ug/L		183	1.80	162.33	2.03	Yes				Yes	Plume Extent
	P314289	7/21/98	Nickel	140.00	ug/L		100	1.40	21.37	6.55	Yes				Yes .	Plume Extent

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Table 2- 9. RFCA-Designated Wells with No Analytes Above Tier II Action Levels

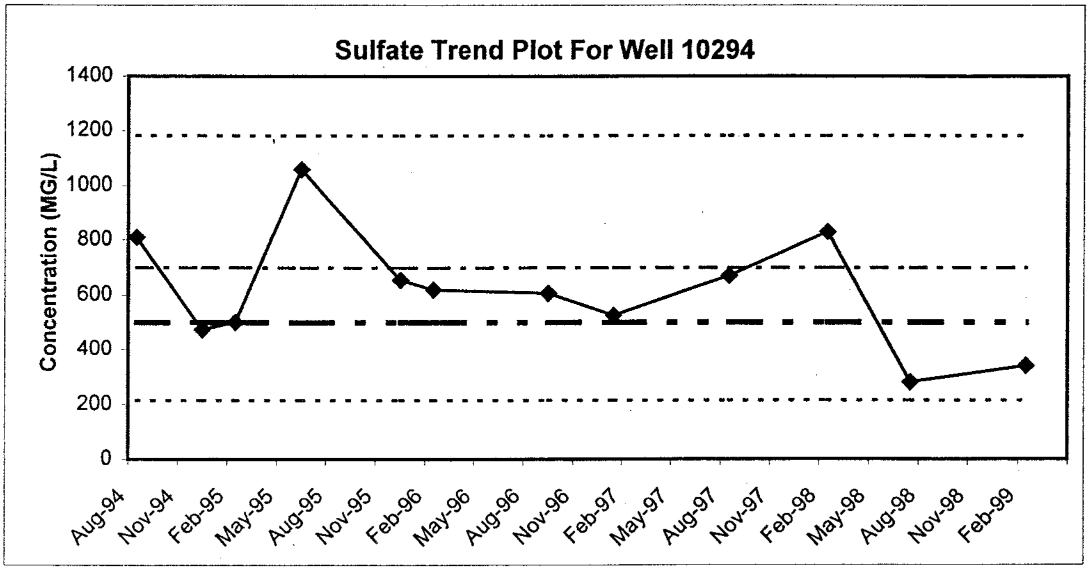
Well Number	IMP Well Class
00197*	PLUME EXTENT
00297*	PLUME DEFINITION
00397*	PLUME EXTENT
02197*	PLUME EXTENT
22596	PLUME EXTENT
22996	PLUME EXTENT
3386	PLUME EXTENT
43392	PLUME EXTENT
4787*	PLUME EXTENT
4887	PLUME EXTENT
6186	PLUME EXTENT
76992	PLUME EXTENT
P209289*	PLUME DEFINITION
P313589	PLUME EXTENT

* Indicates well was dry throughout 1998

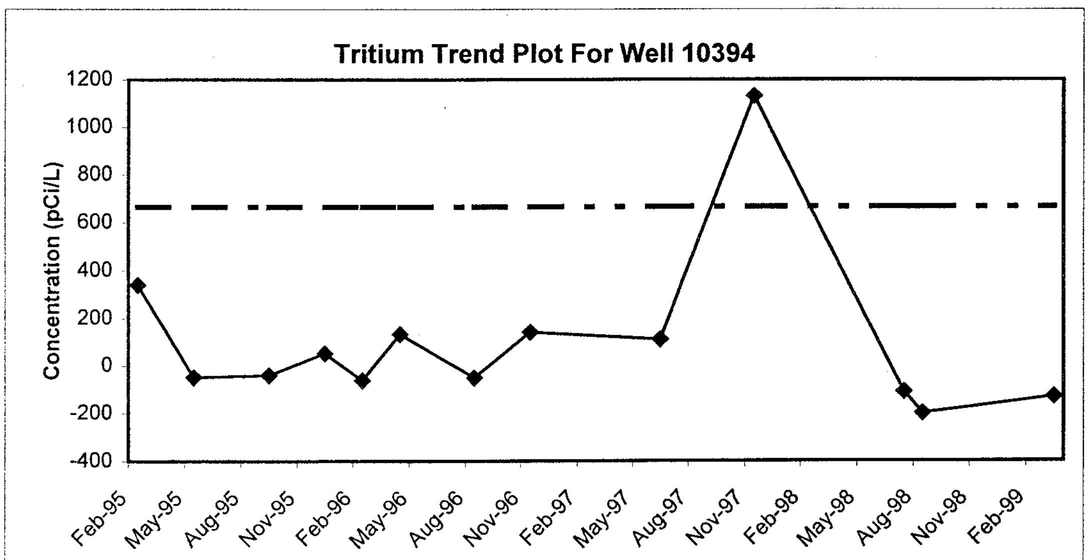
The uranium isotopes U-233/234, U-235, and U-238 were detected above Tier II action levels in all six Boundary wells. All of the uranium isotope analytical results were below the background M2SD benchmarks, and are not considered reportable values. Monthly confirmation sampling for tritium at well 10394, initiated in 1998 as a result of an above Tier II action level result (1,130 pCi/L) reported for the November 25, 1997, sampling event, failed to confirm the presence of tritium in this well at above Tier II action levels (Figure 2-2). It is, therefore, concluded that the tritium exceedance was a spurious analytical result.

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

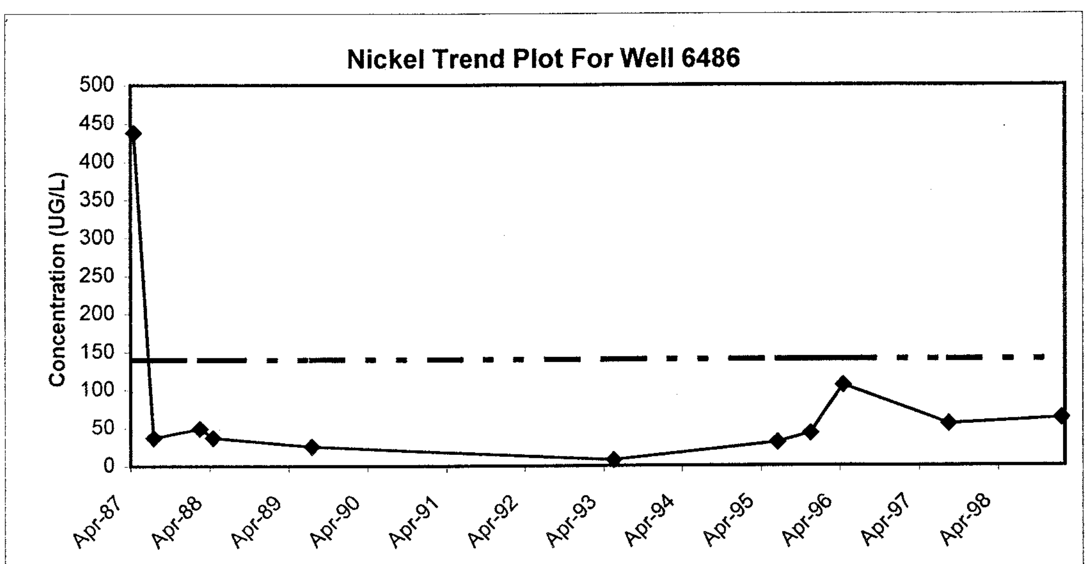
2-1



2-2



2-3

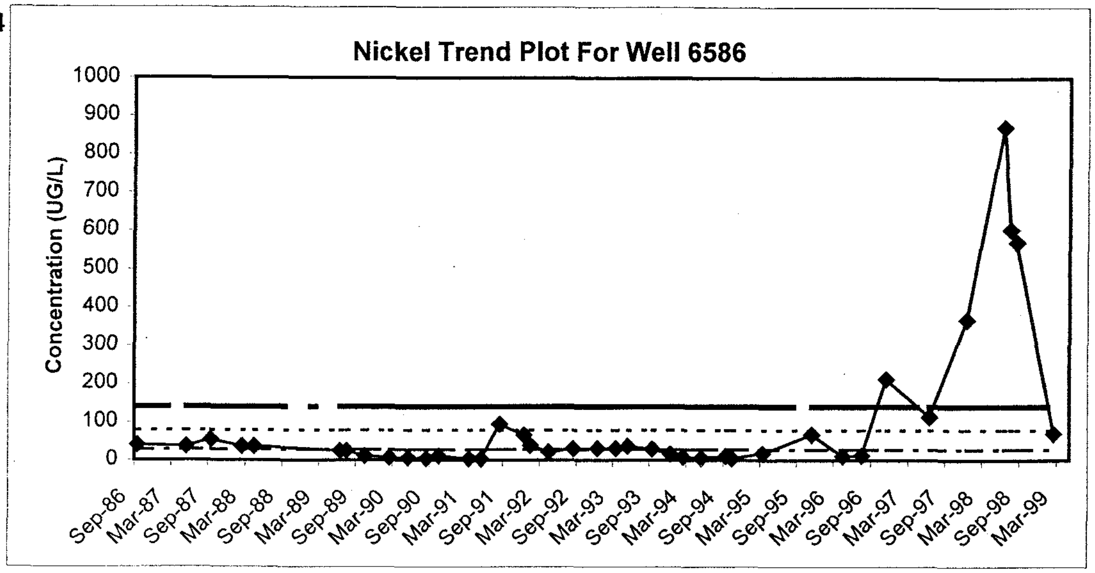


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

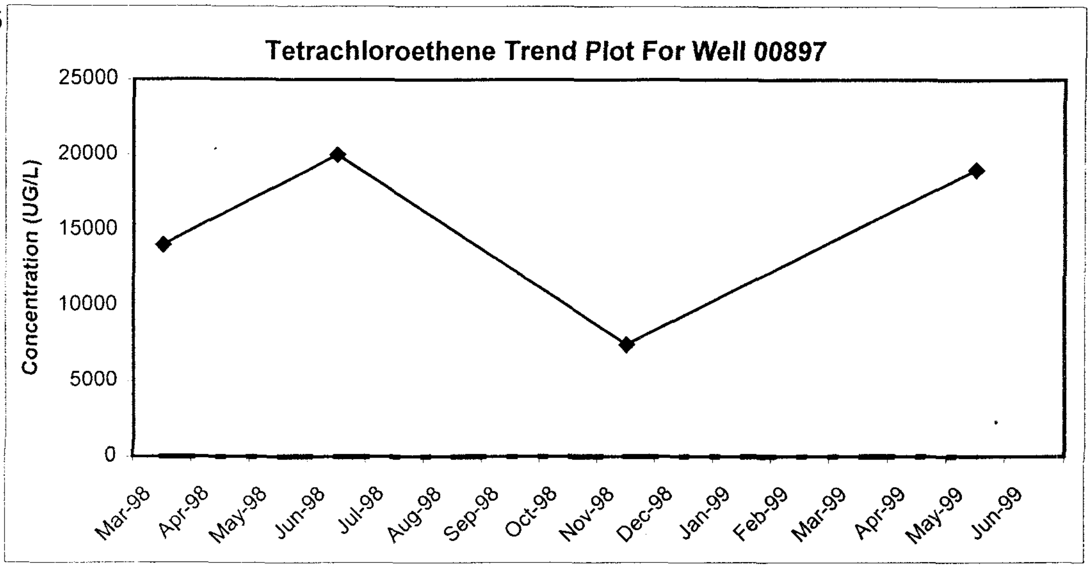
65

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

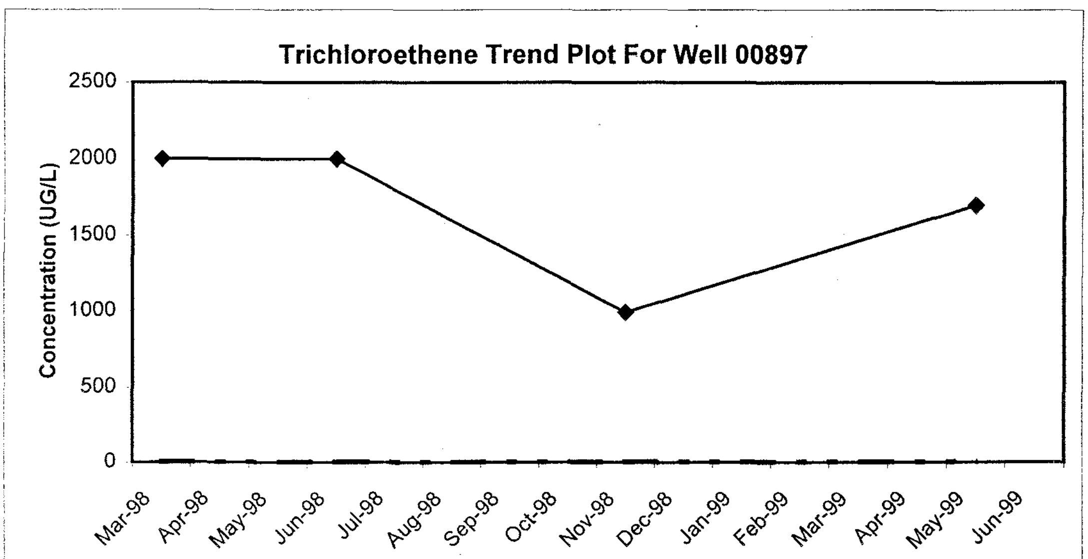
2-4



2-5



2-6

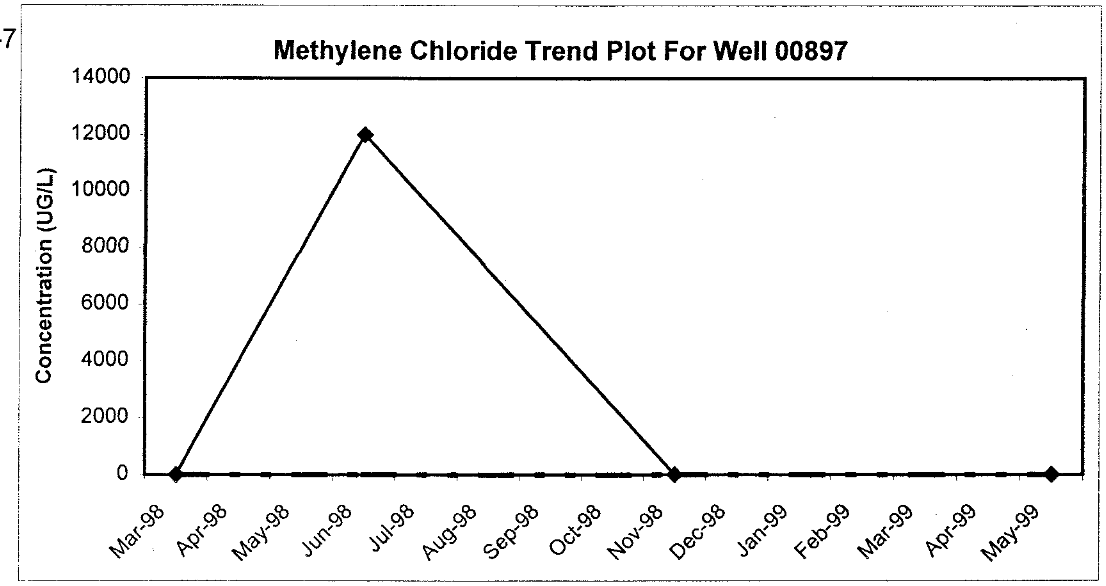


Heavy mixed dashed lines = Tier II Action Level
Light *uniform* dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

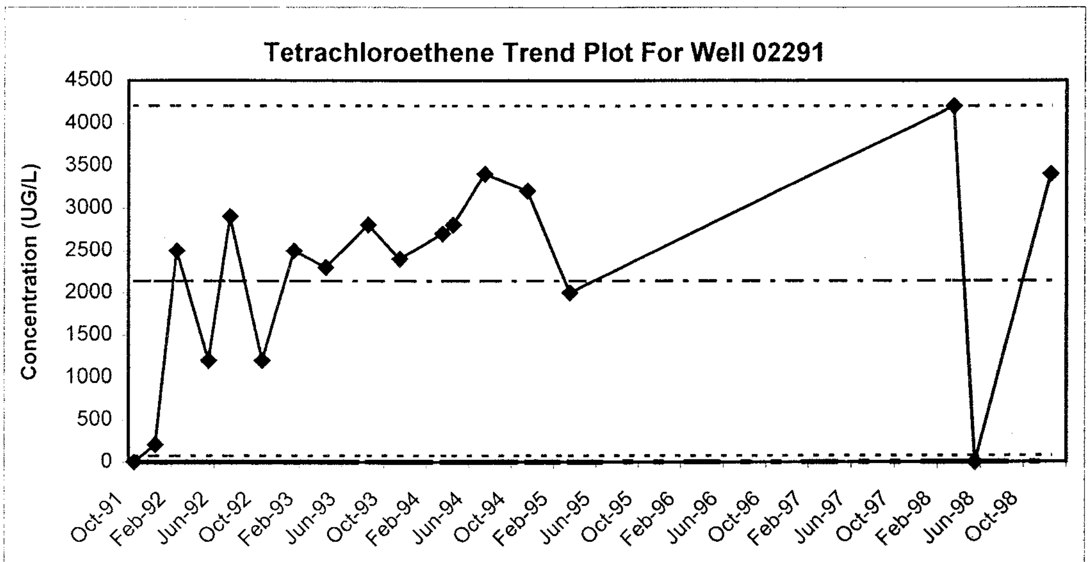
66

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

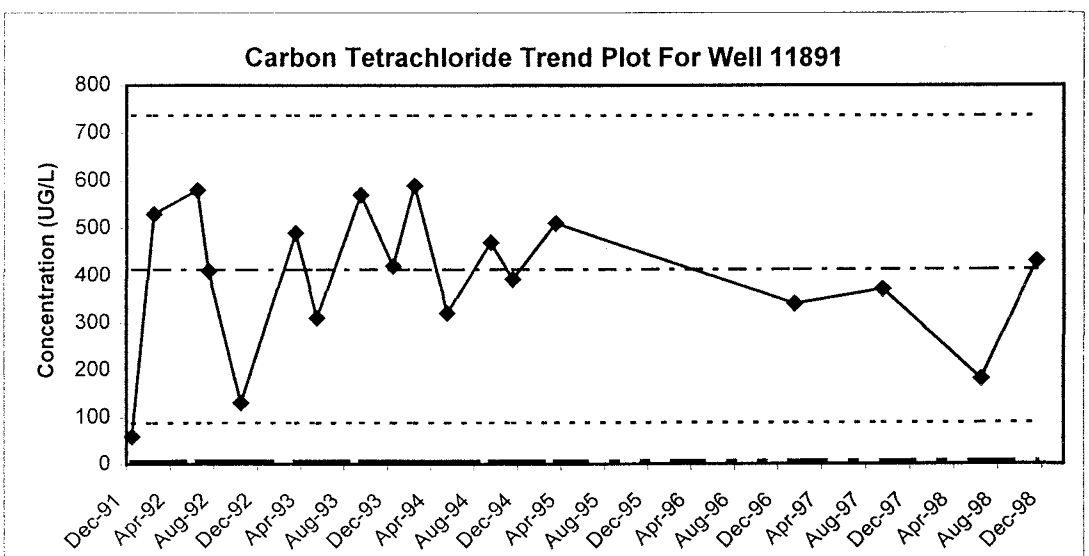
2-7



2-8



2-9

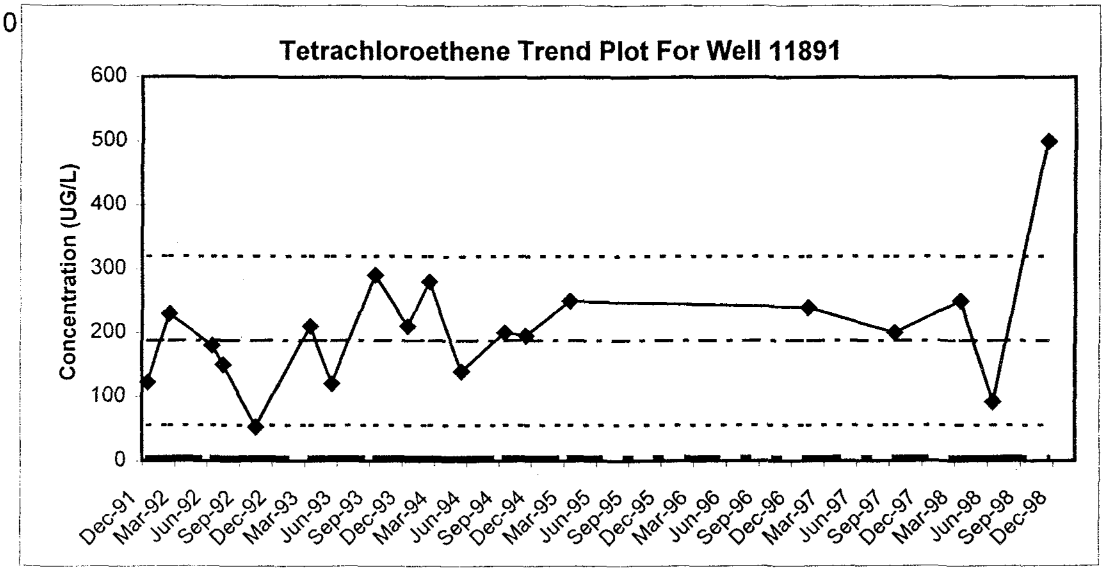


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

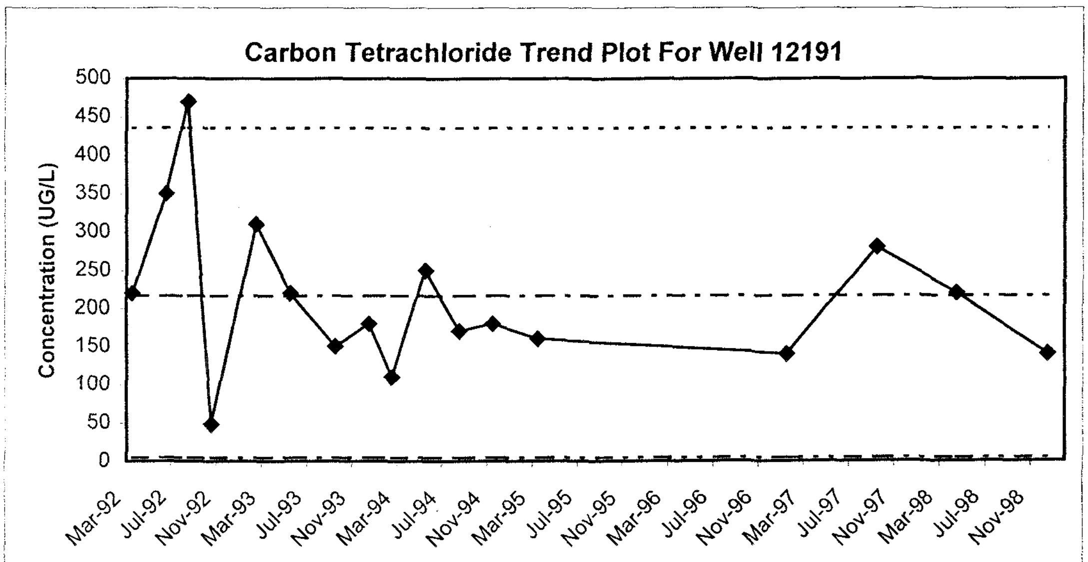
67

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

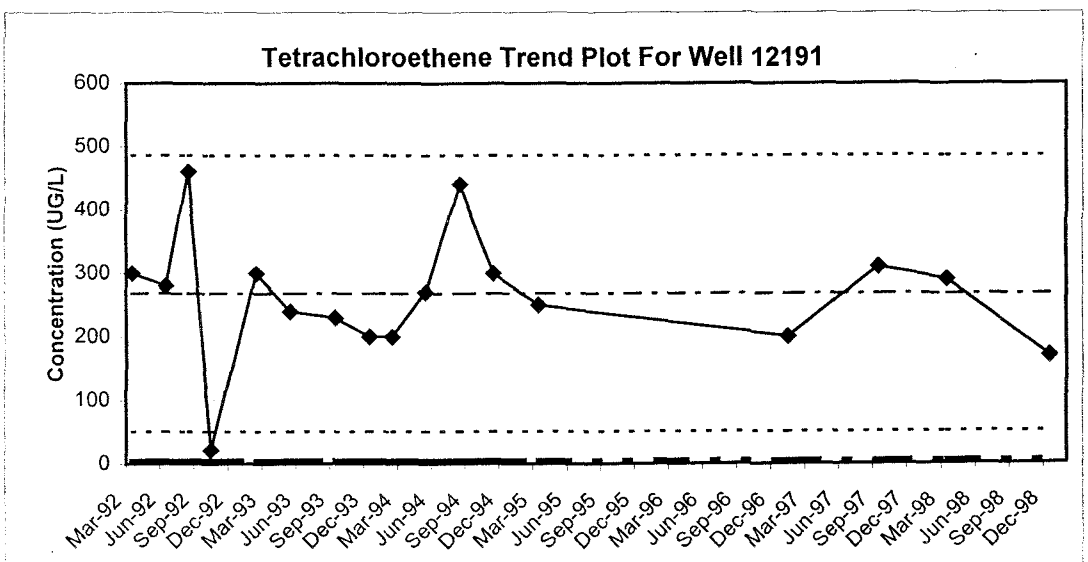
2-10



2-11



2-12

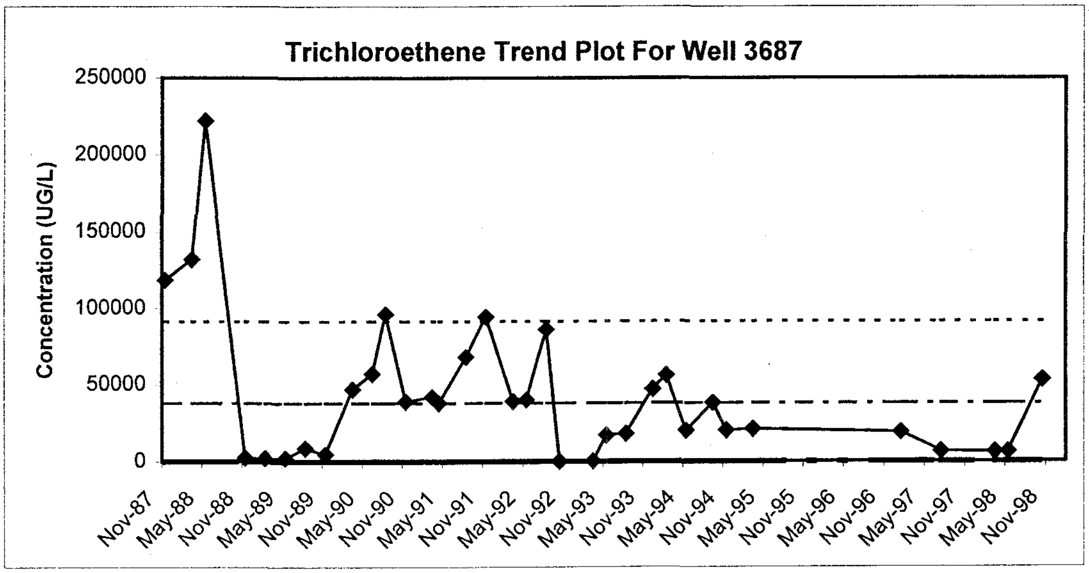


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

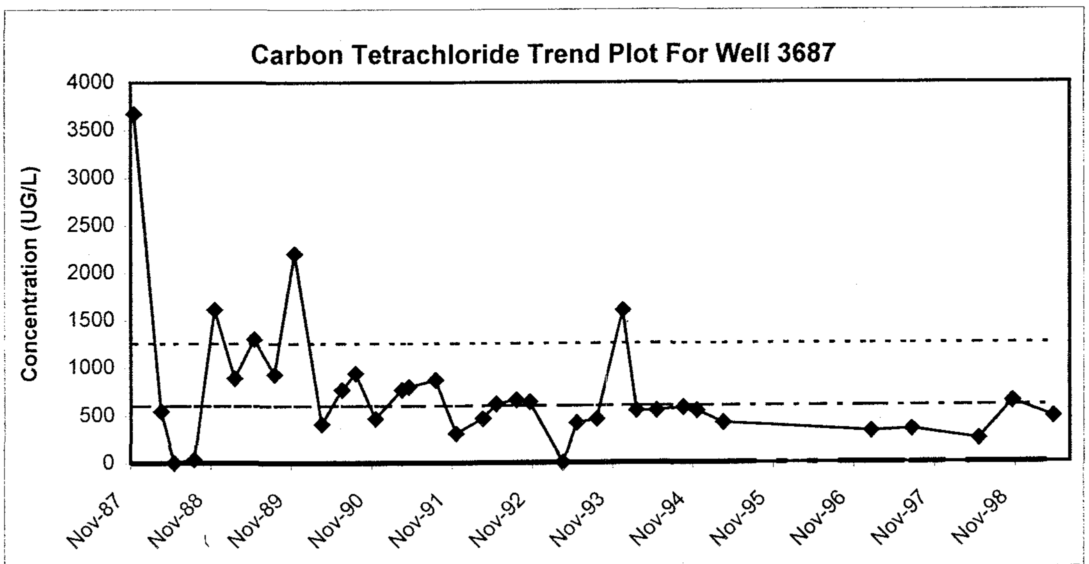
68

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

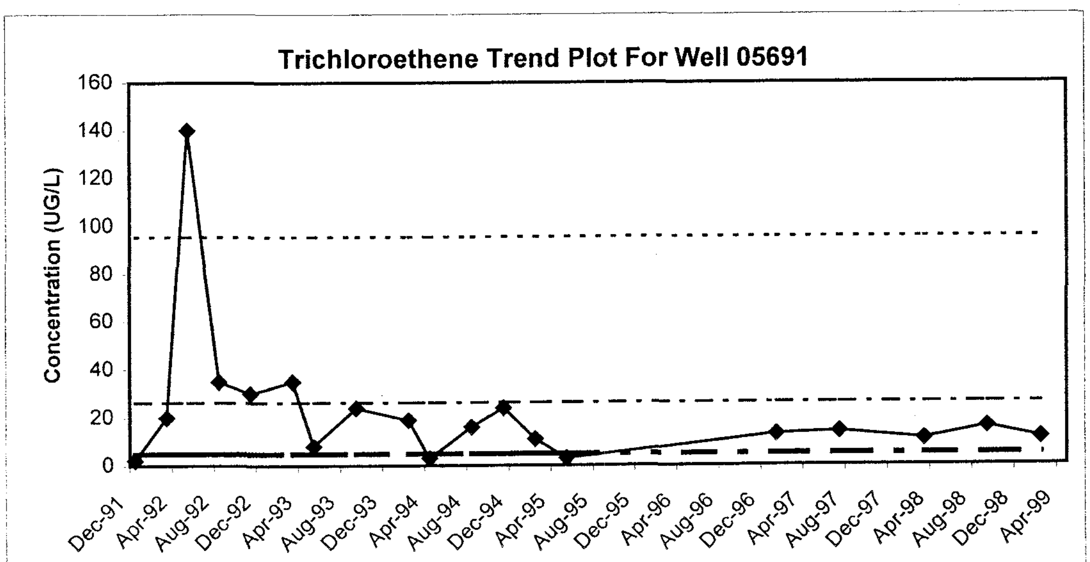
2-13



2-14



2-15

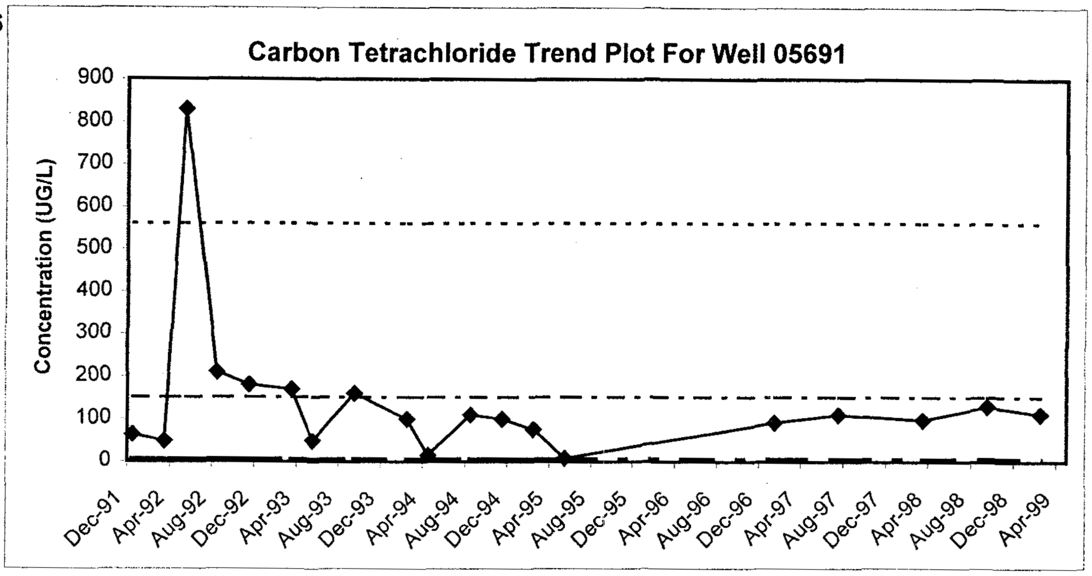


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

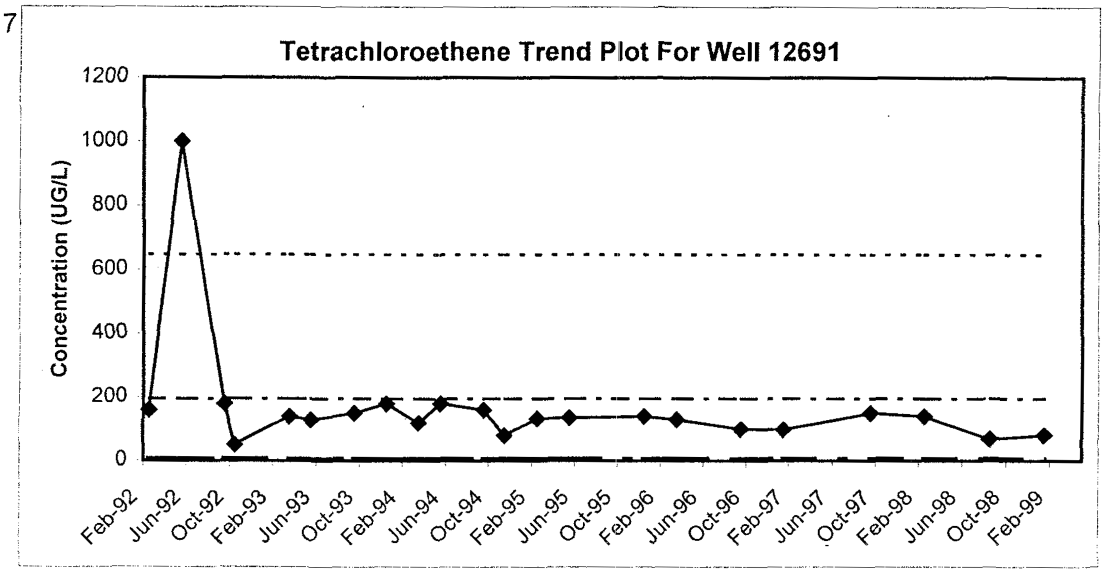
69

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

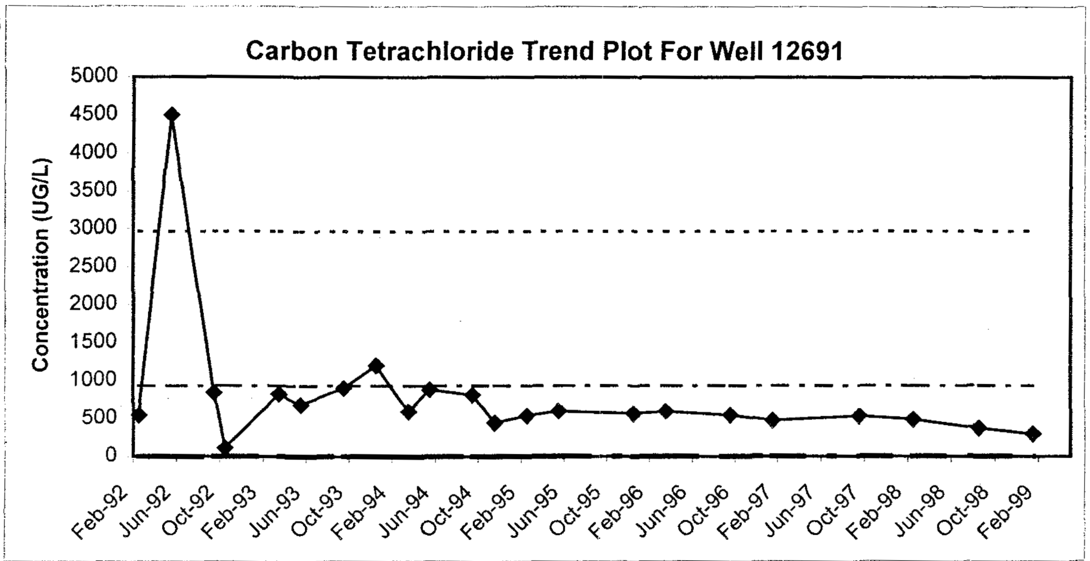
2-16



2-17



2-18

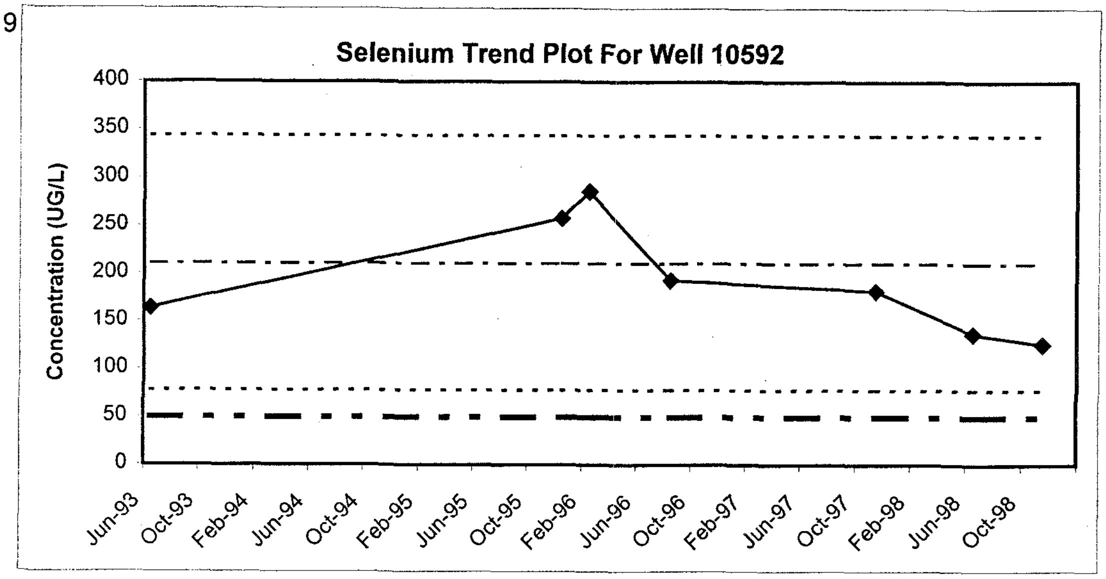


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

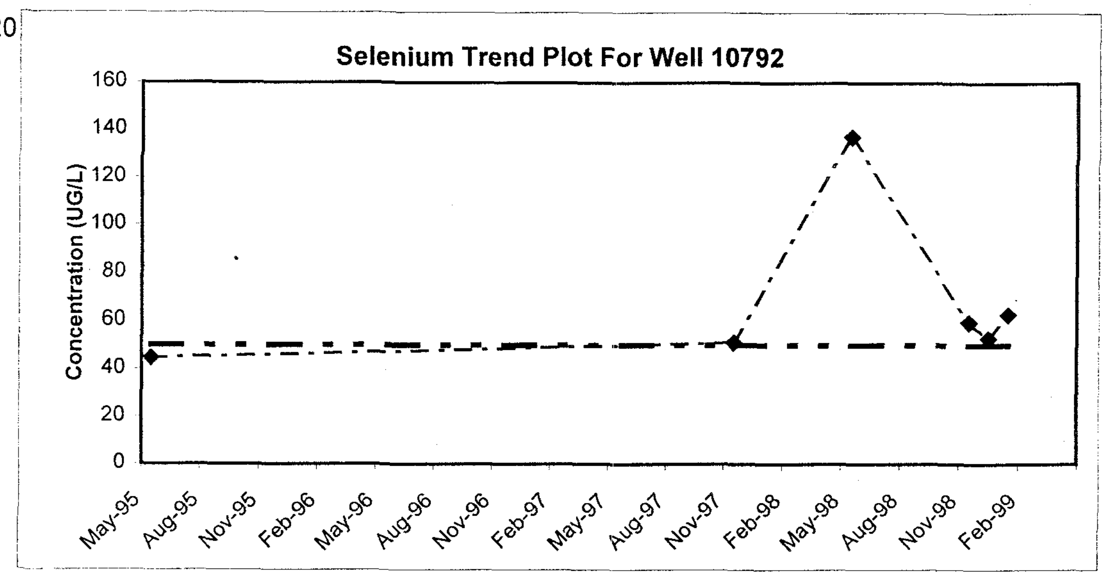
70

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

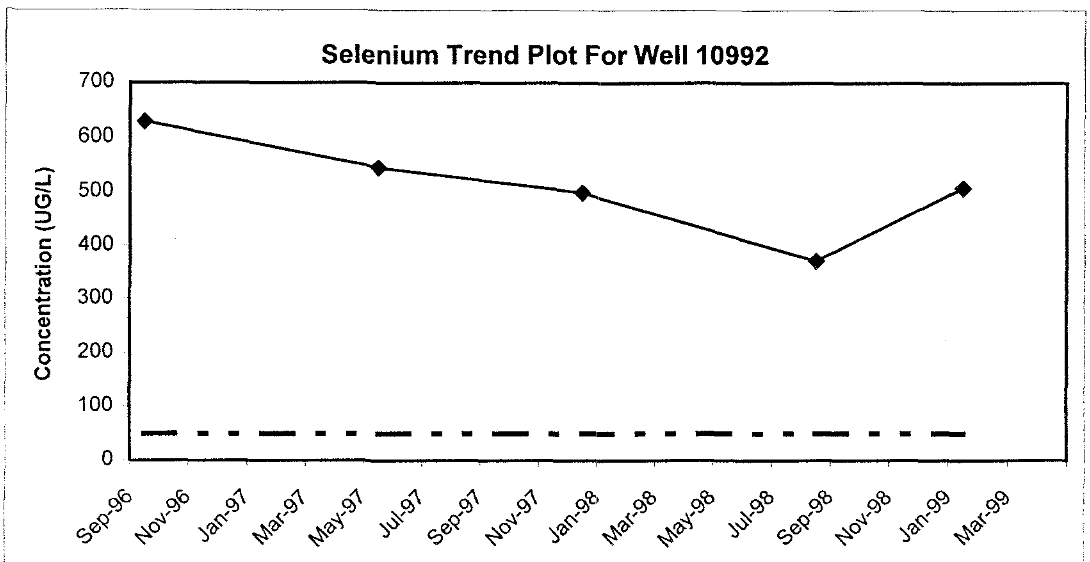
2-19



2-20



2-21

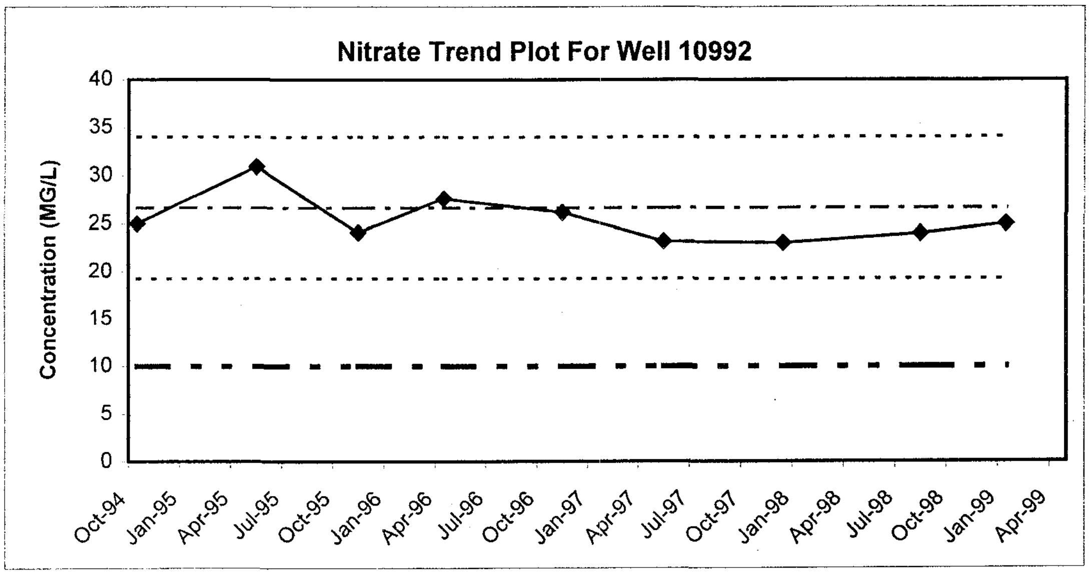


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

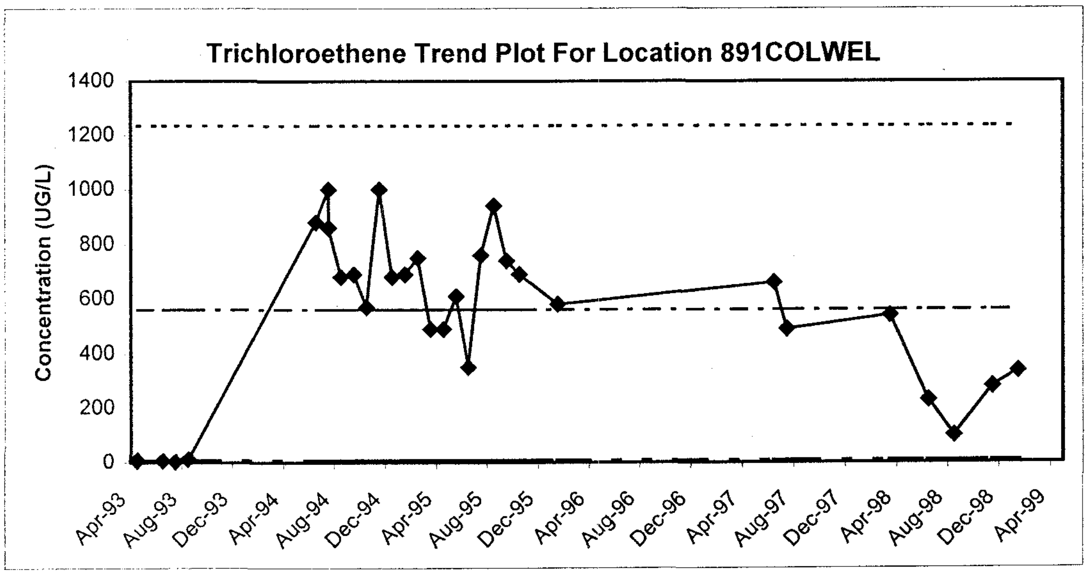
71

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

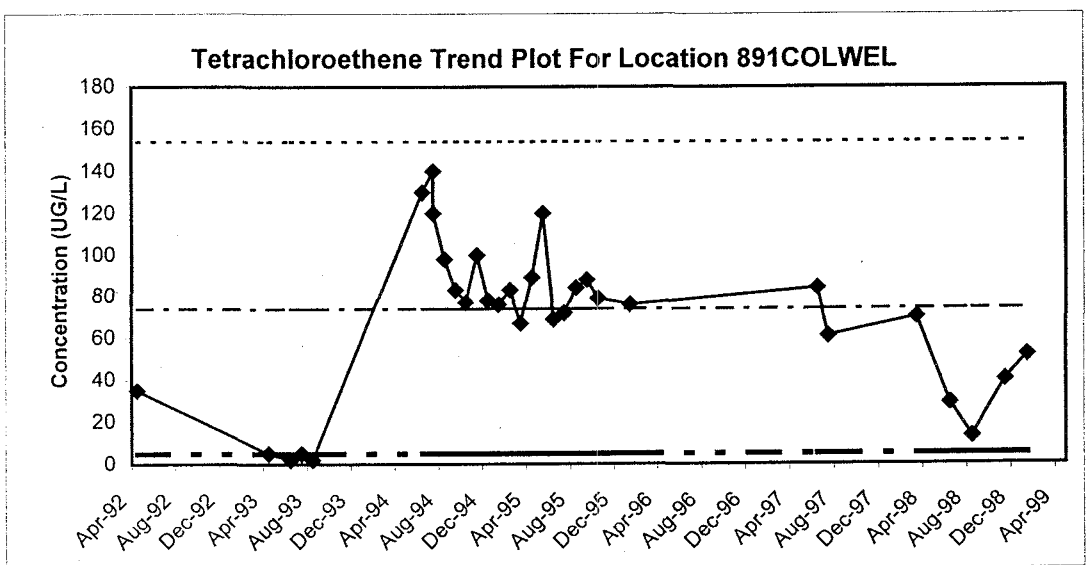
2-22



2-23



2-24

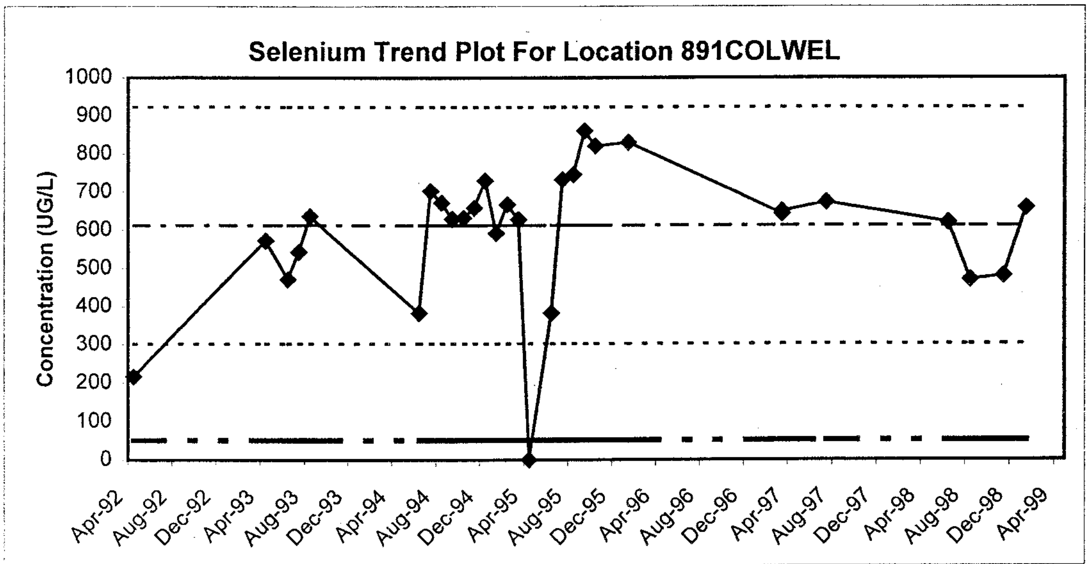


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

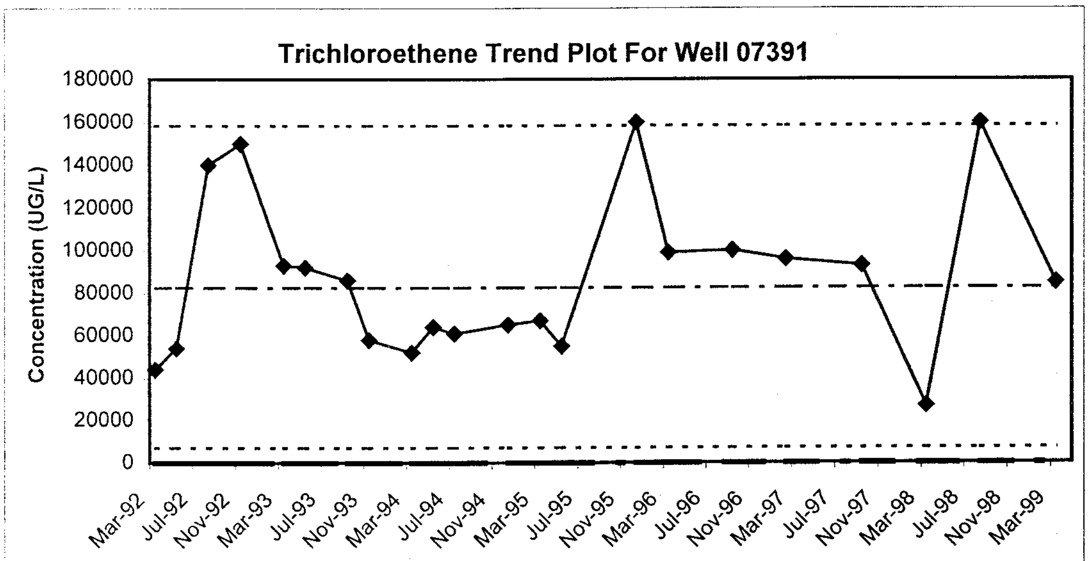
72

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

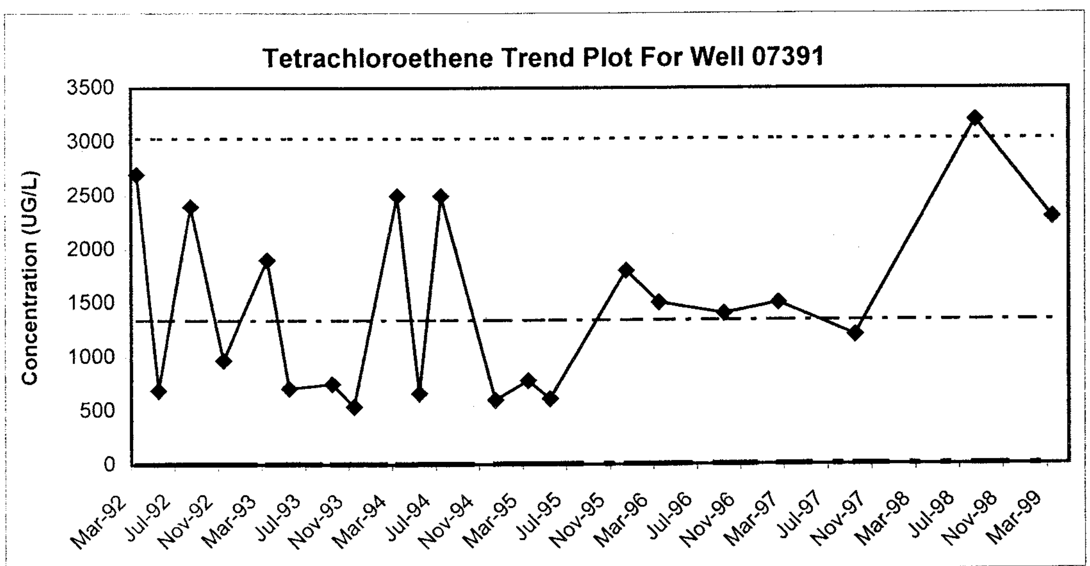
2-25



2-26



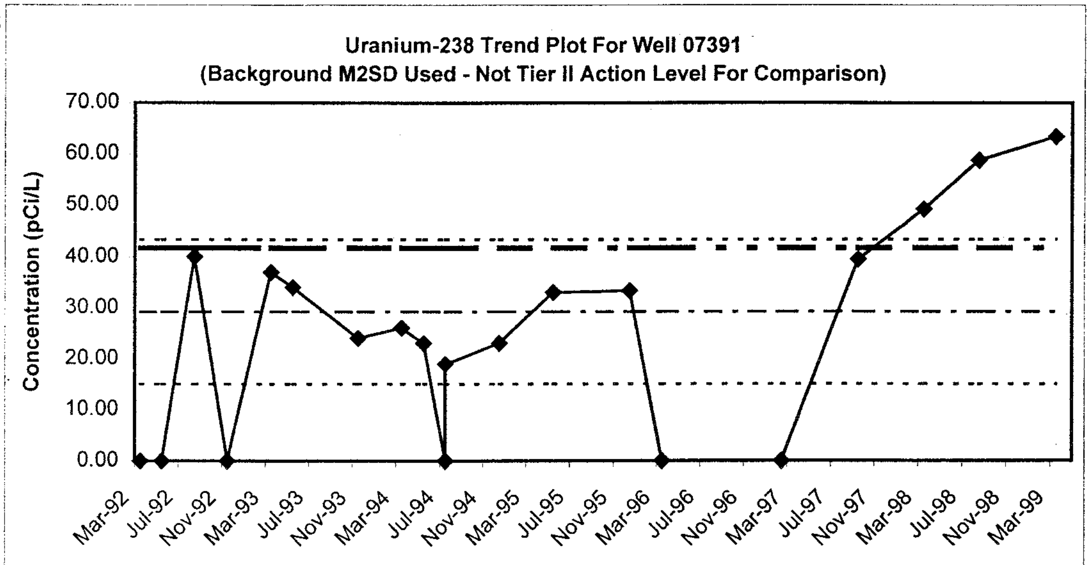
2-27



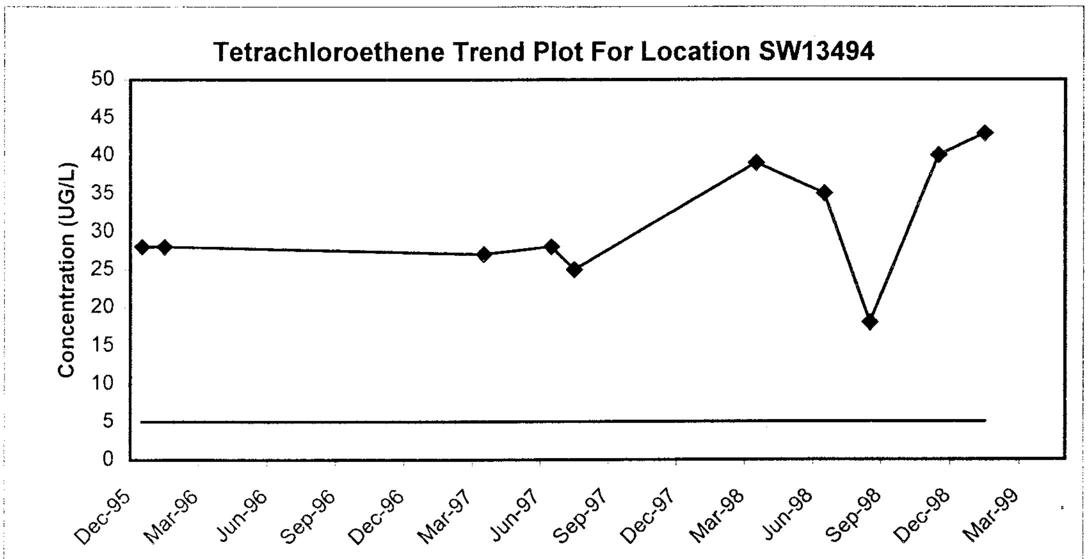
Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

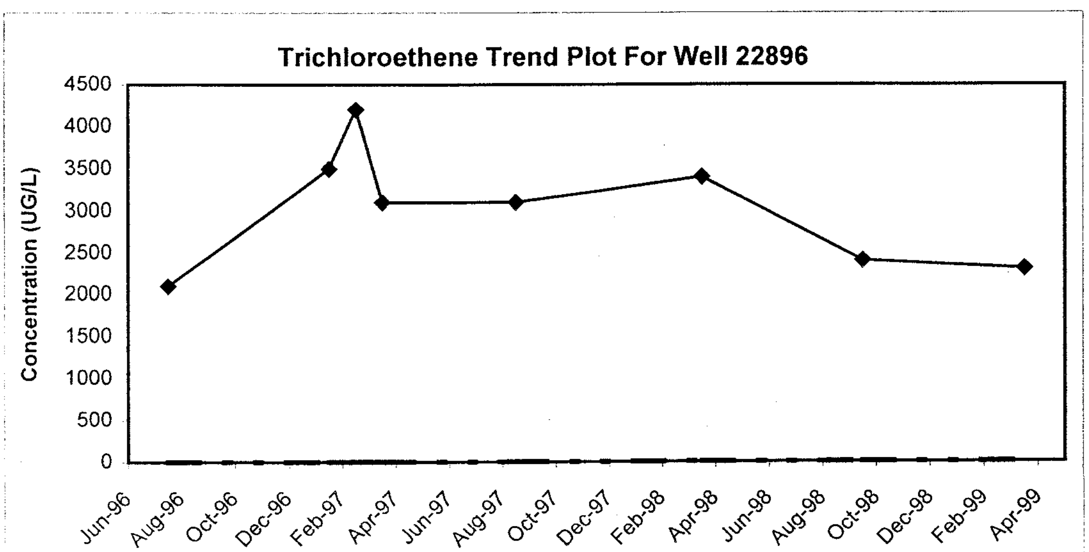
2-28



2-29



2-30



Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

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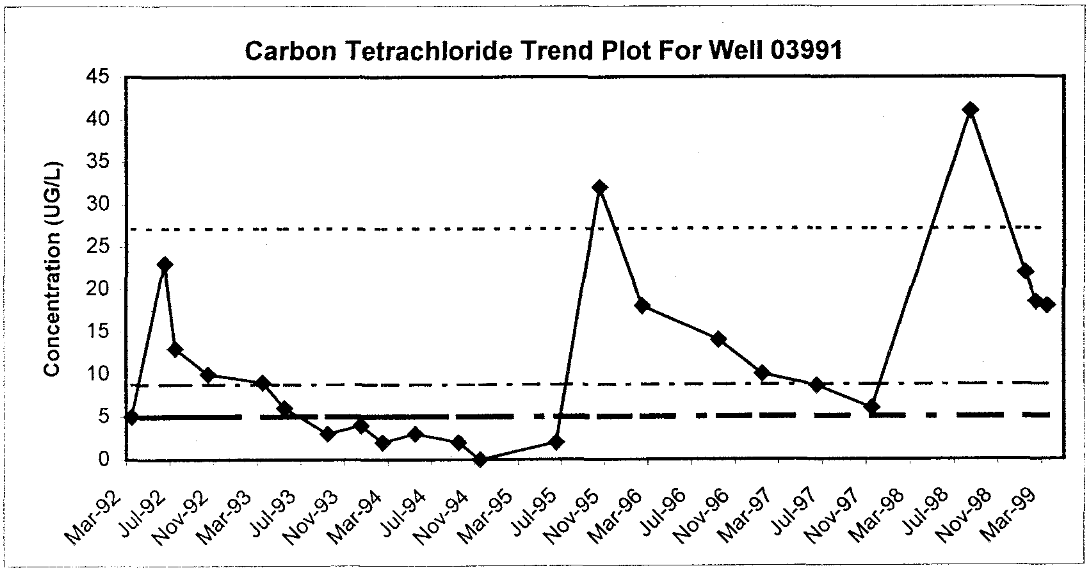
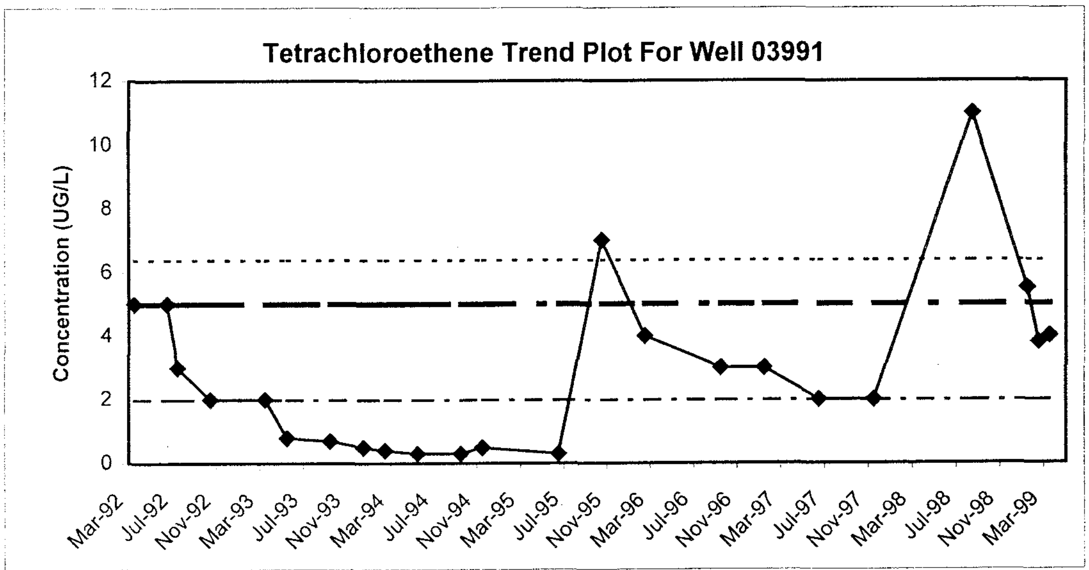
Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

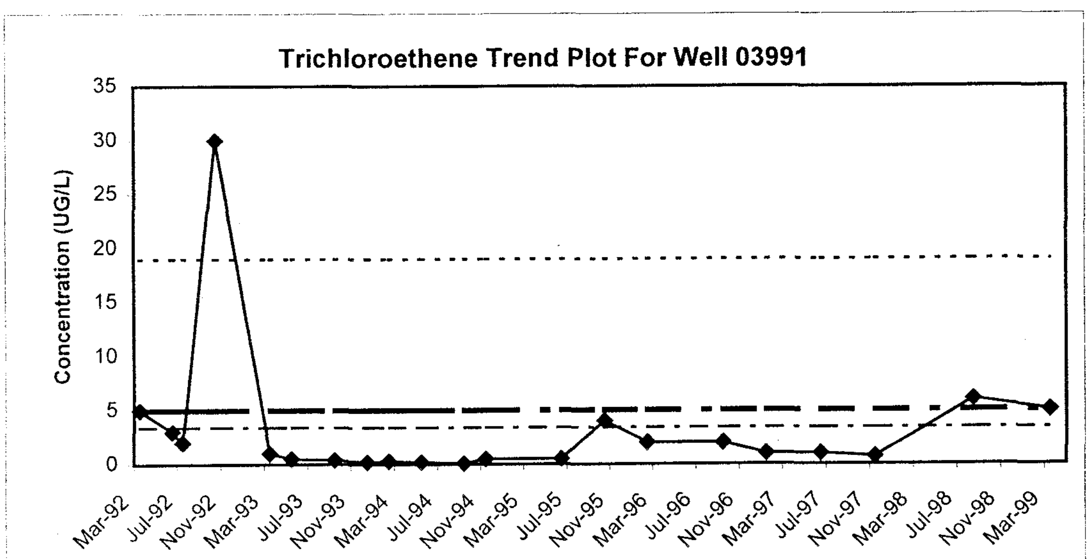
2-31



2-32



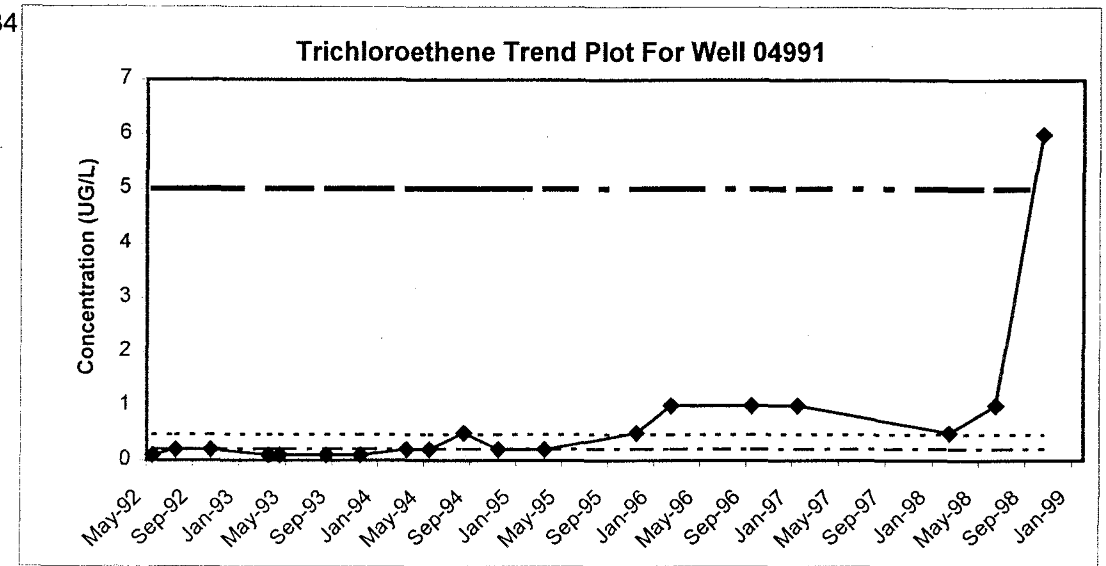
2-33



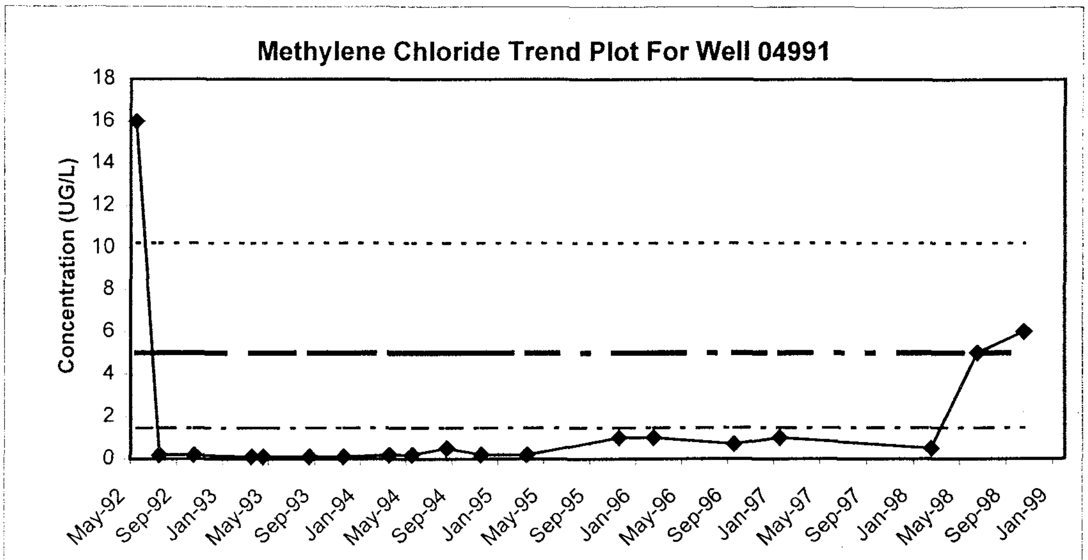
Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

75

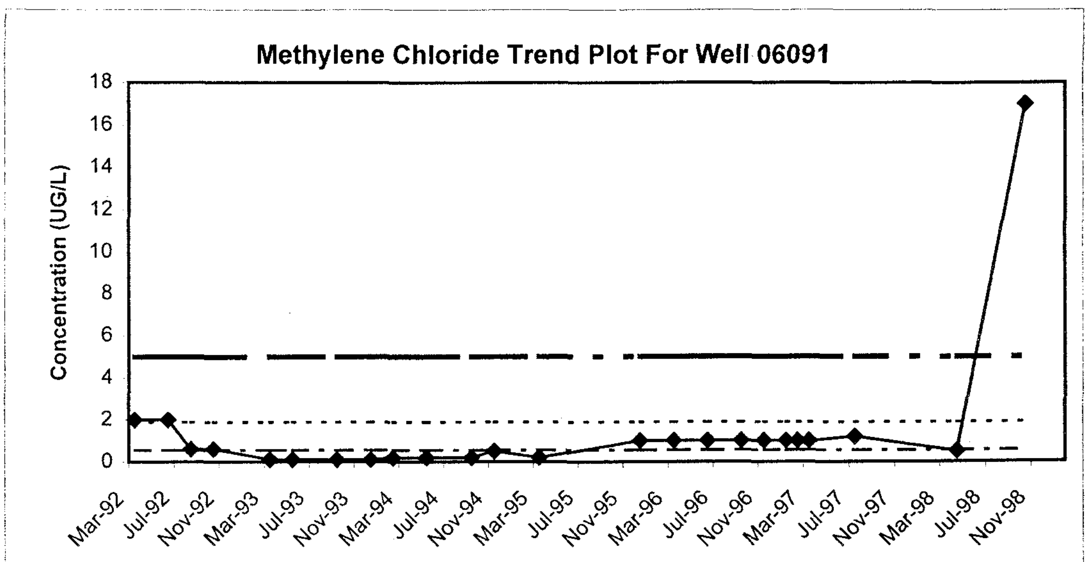
2-34



2-35



2-36



Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

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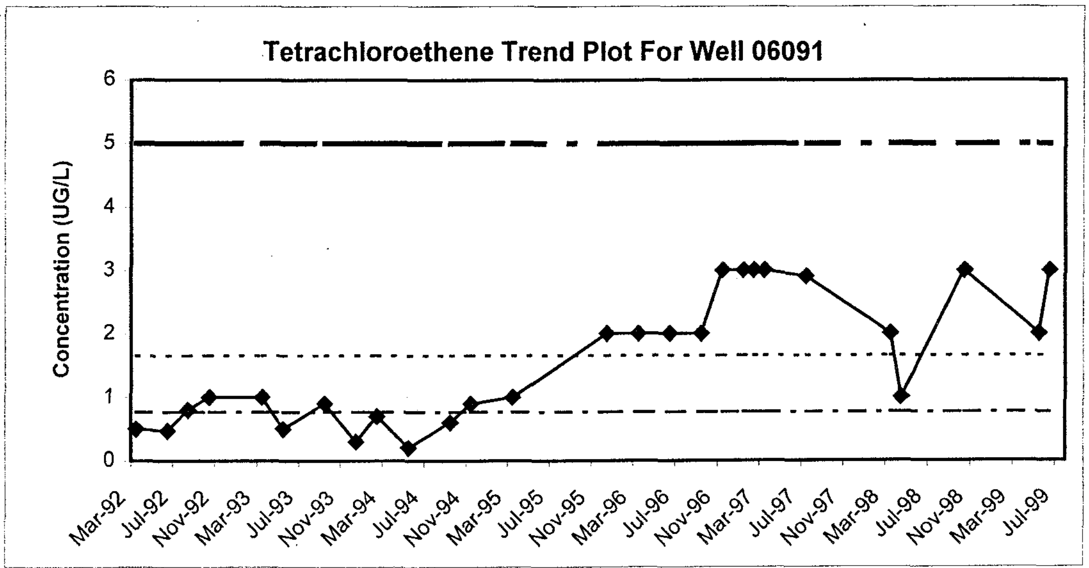
Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

2-37



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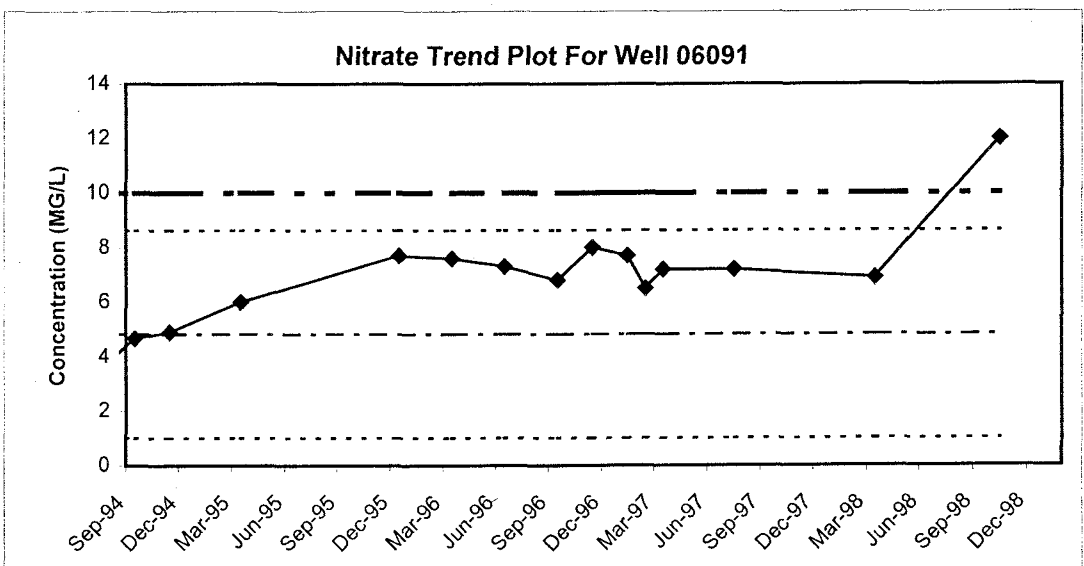

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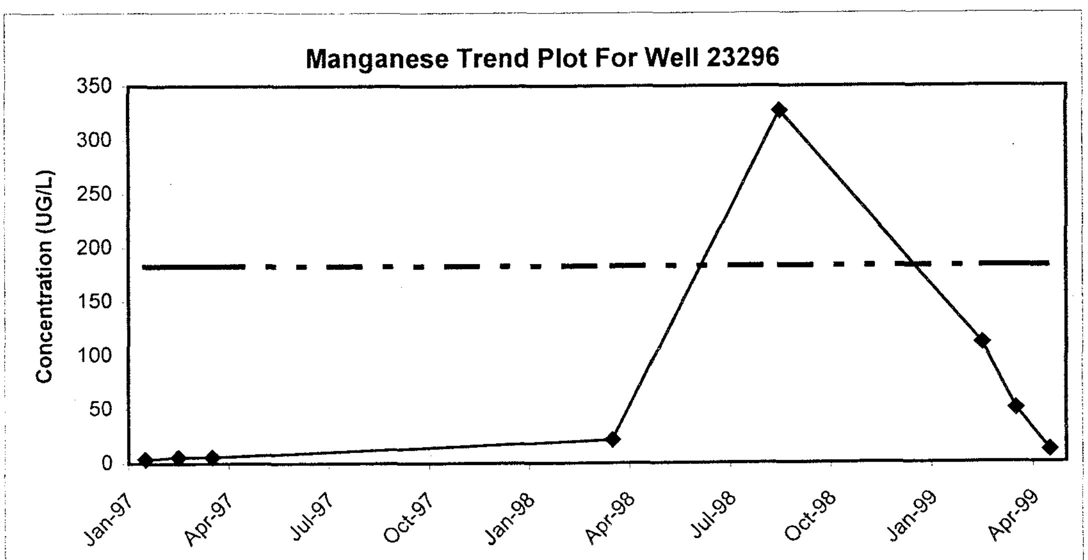
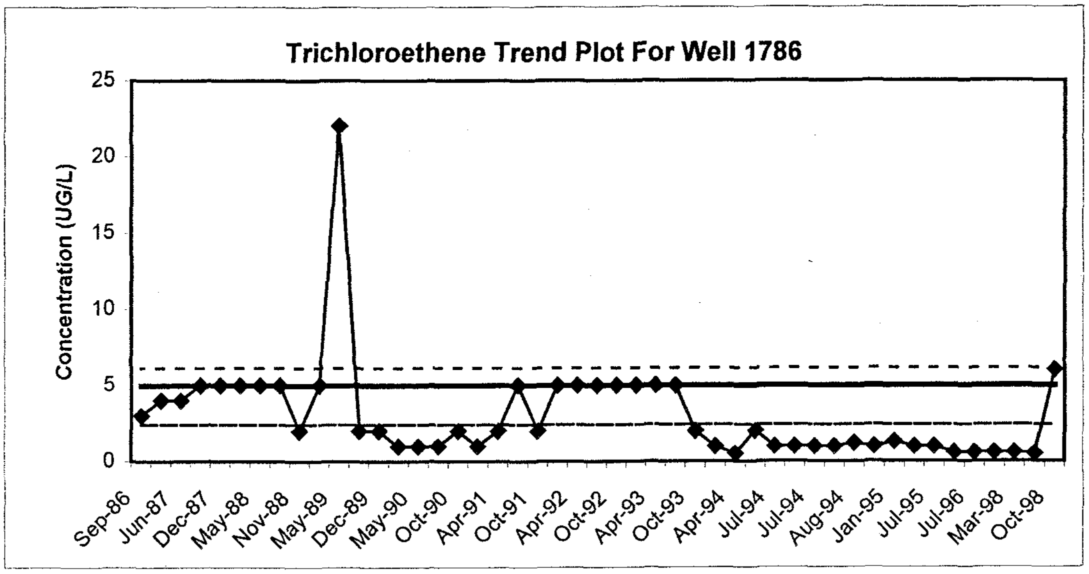


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

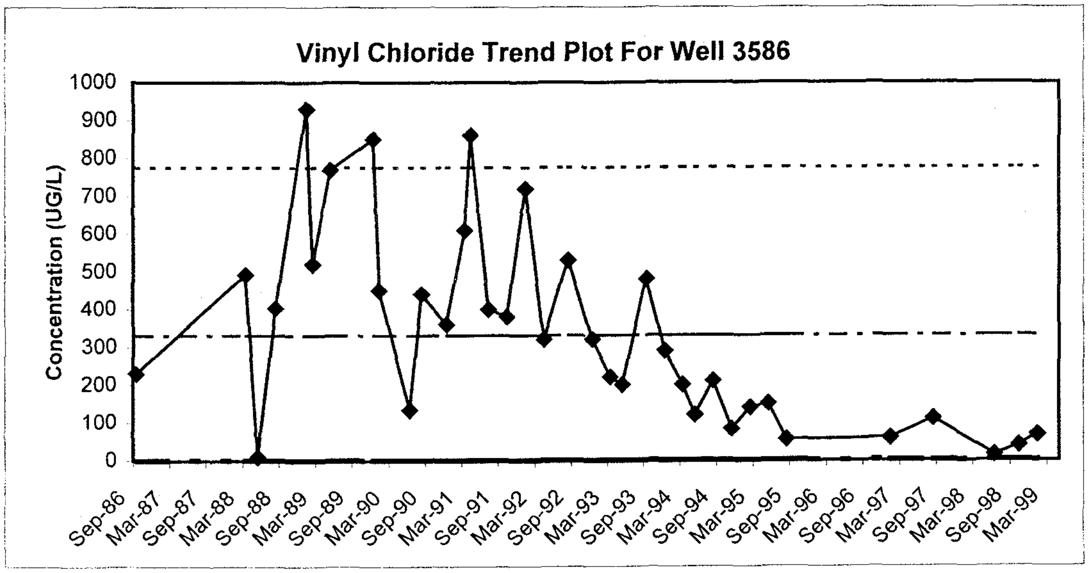
77

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

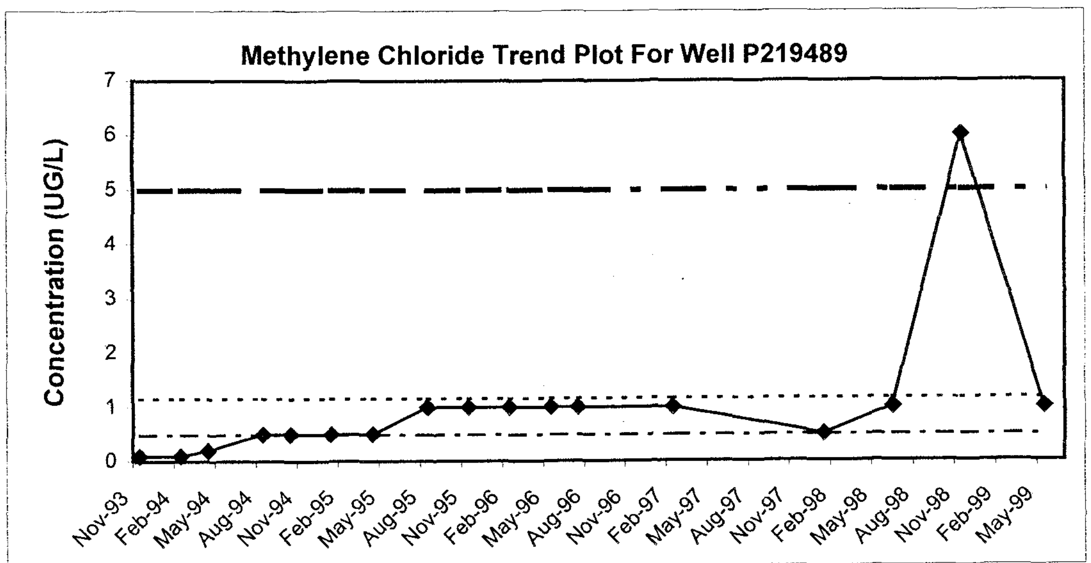
2-40



2-41



2-42

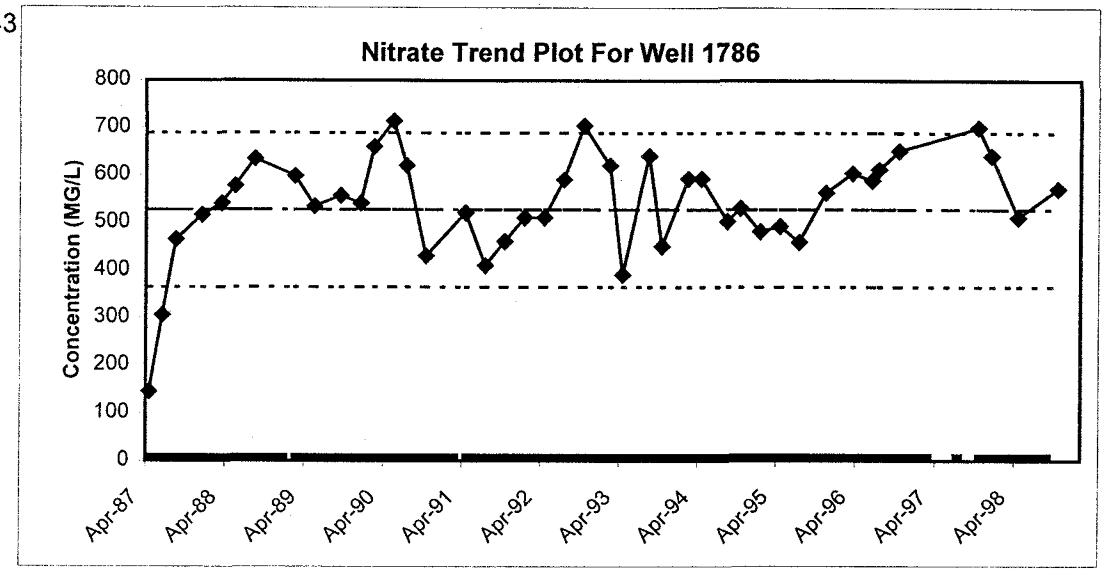


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

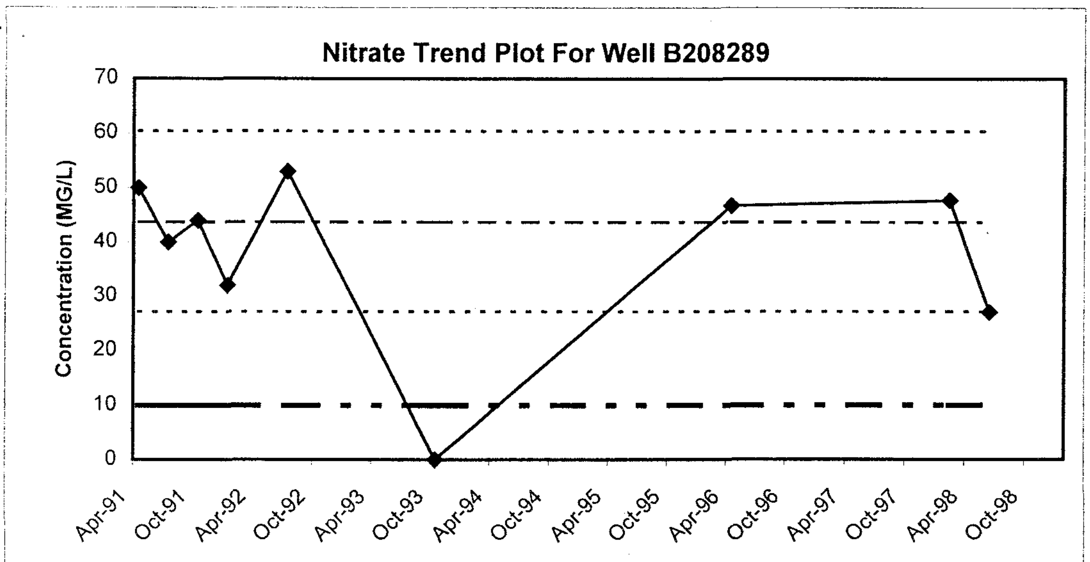
78

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

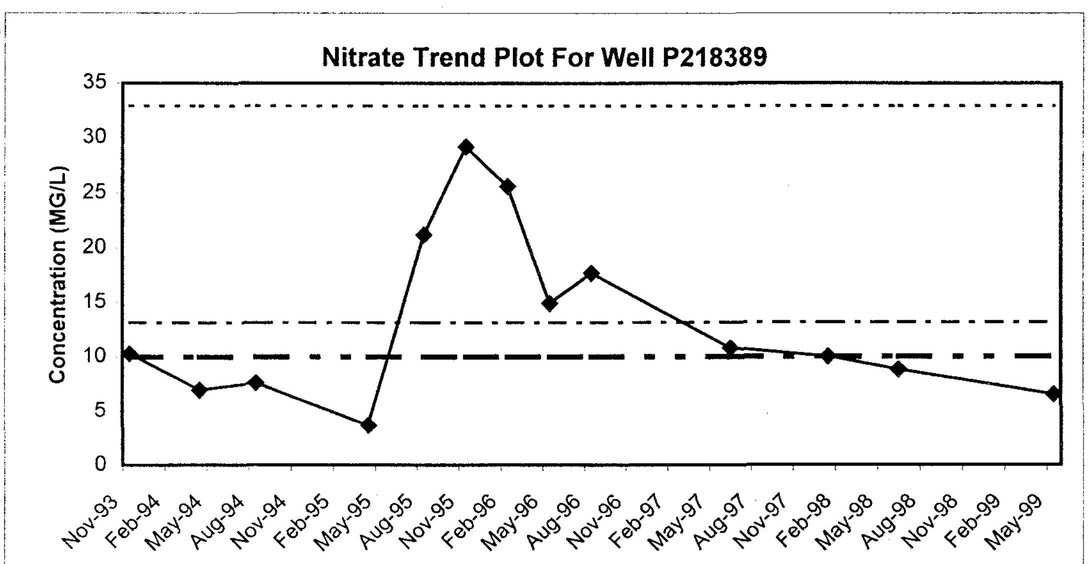
2-43



2-44



2-45

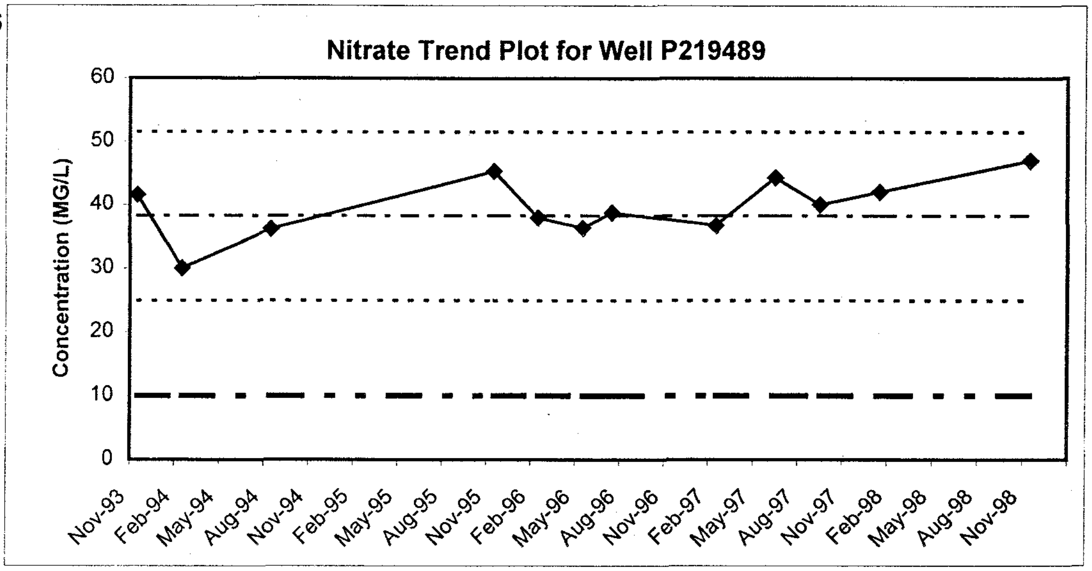


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

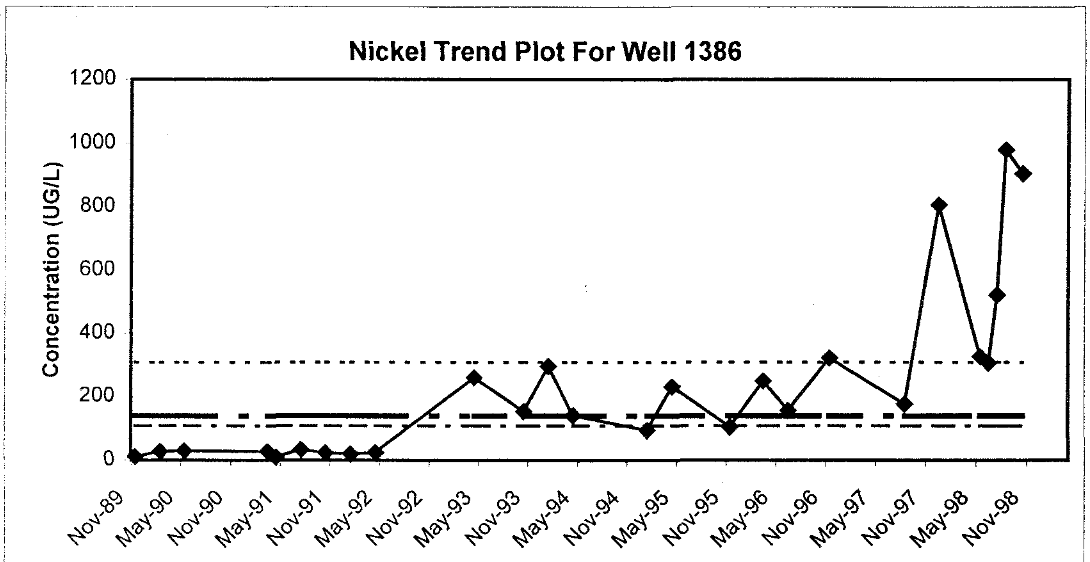
79

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

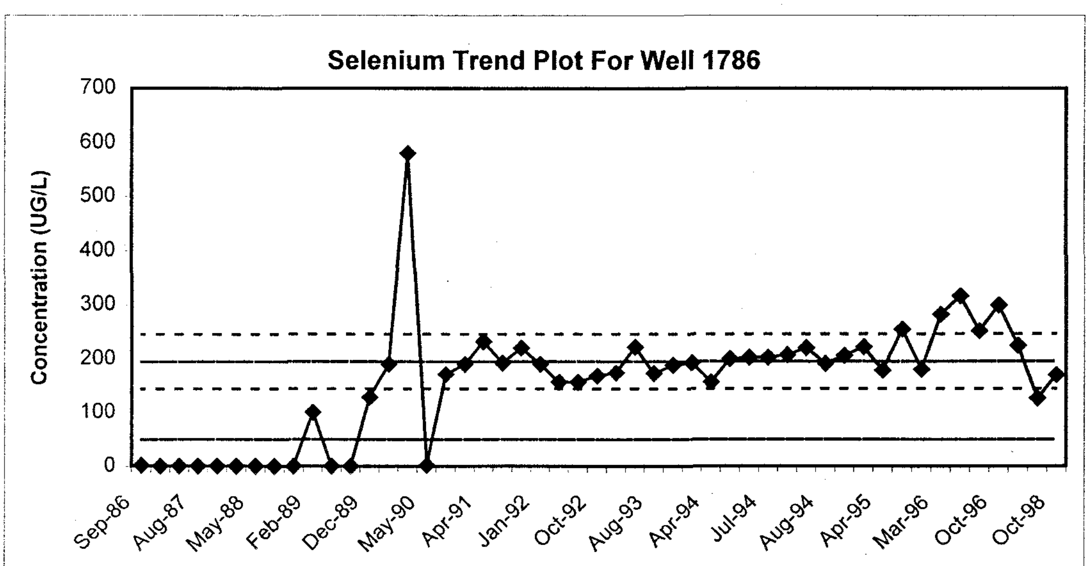
2-46



2-47



2-48

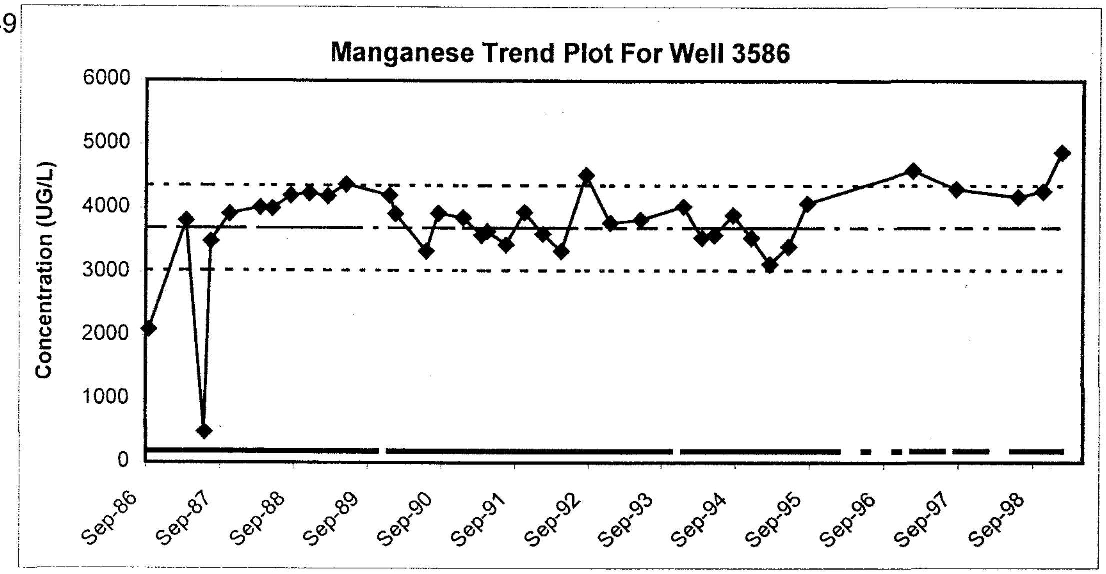


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

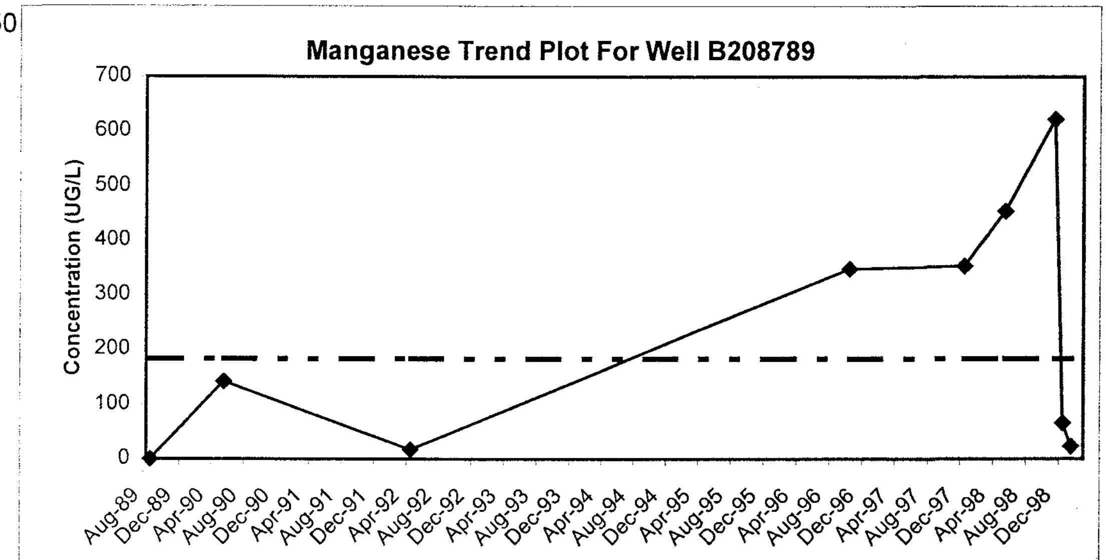
80

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

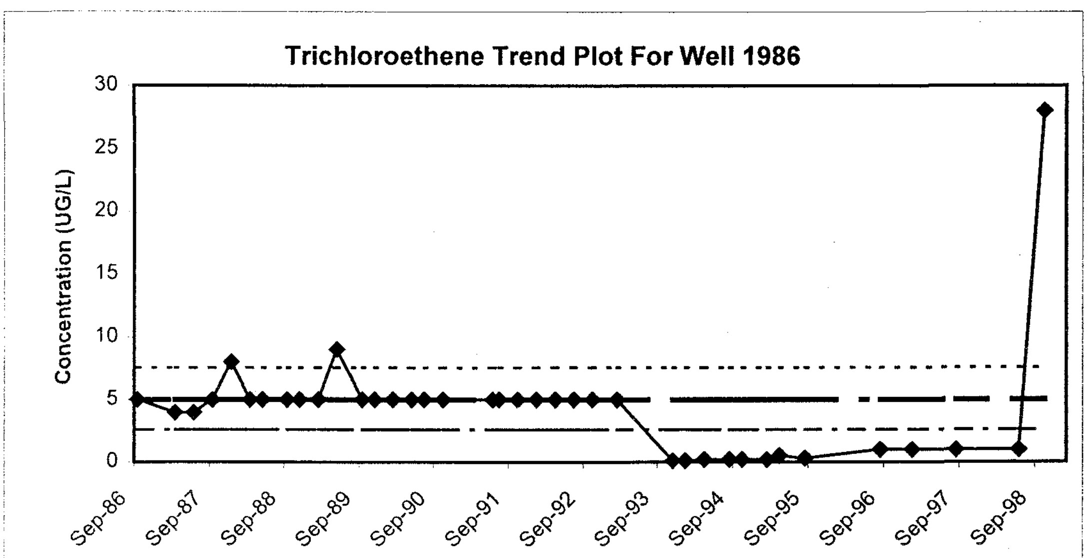
2-49



2-50



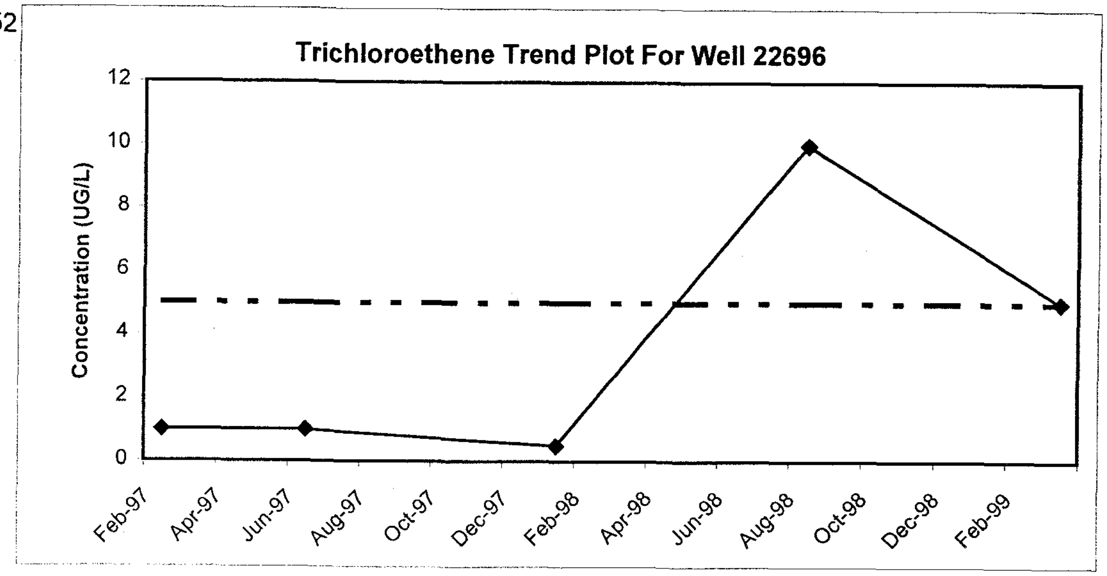
2-51



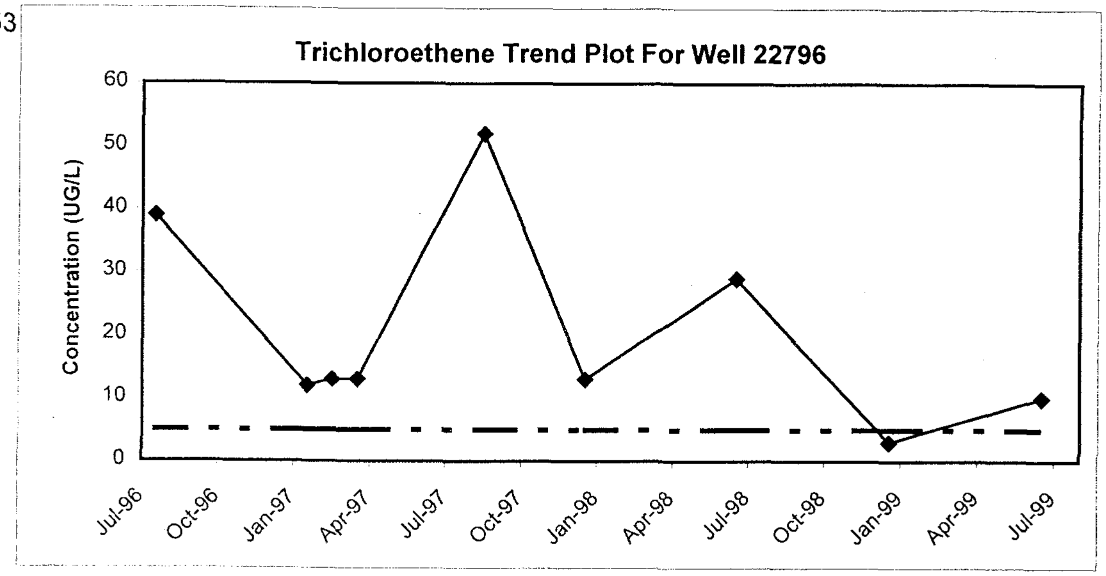
Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

81

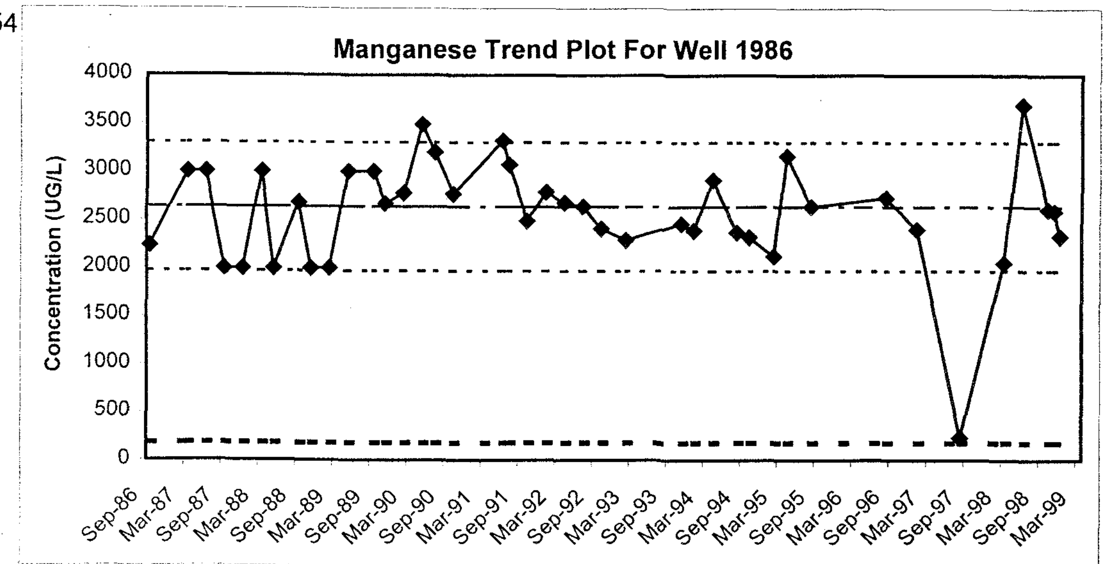
2-52



2-53



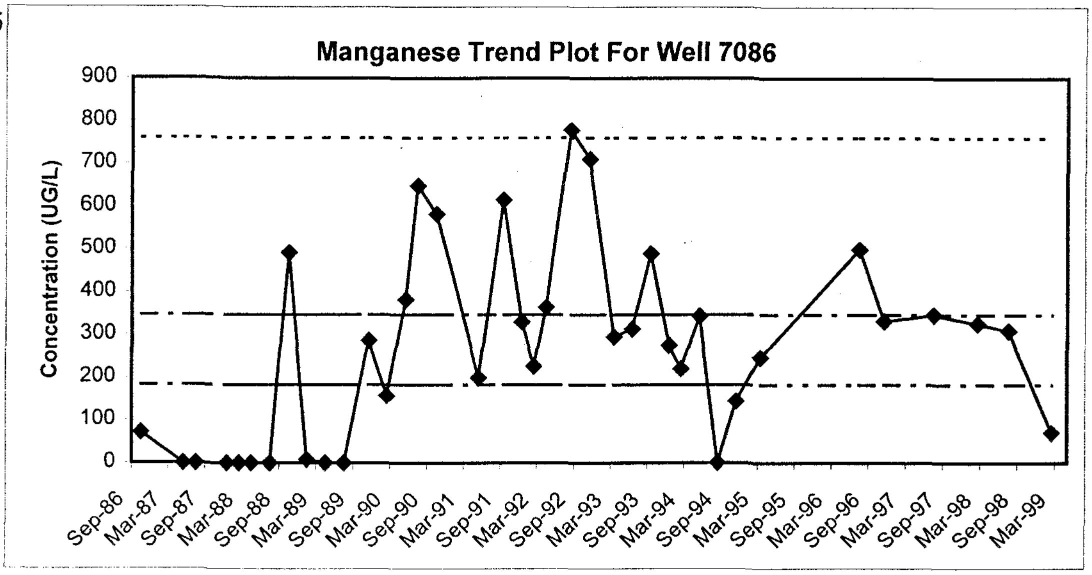
2-54



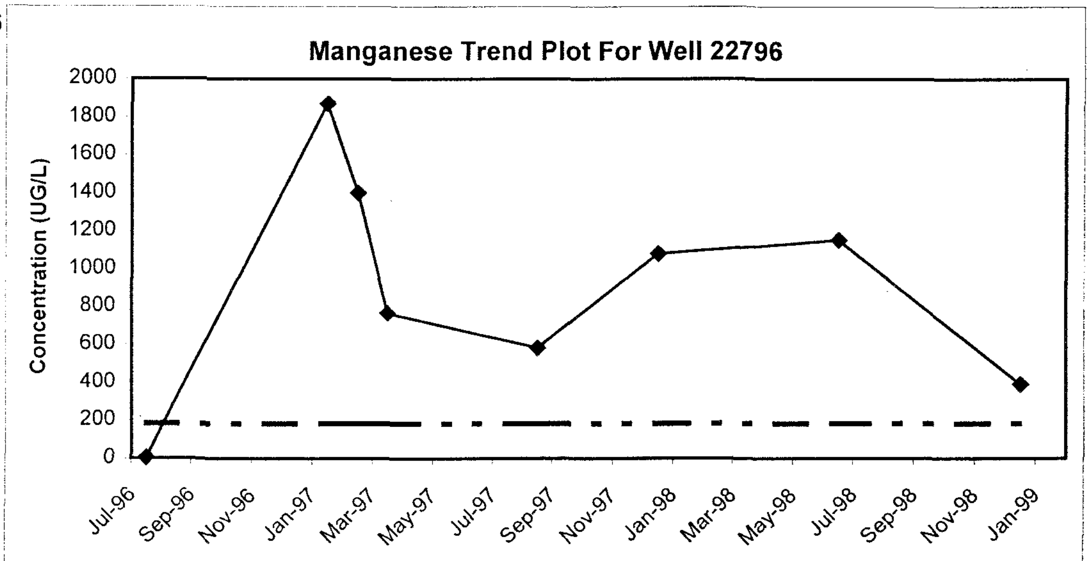
Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

82

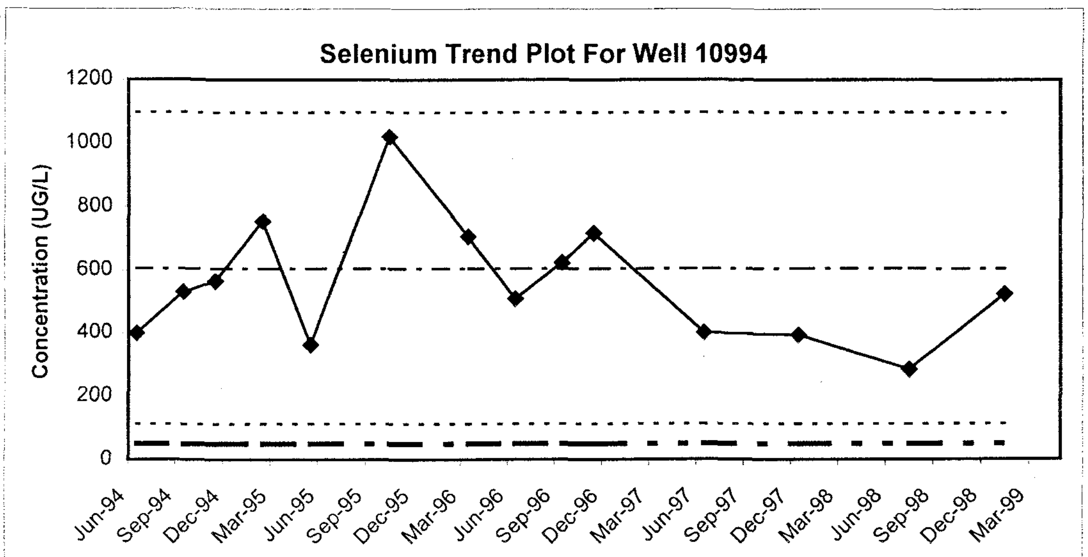
2-55



2-56



2-57

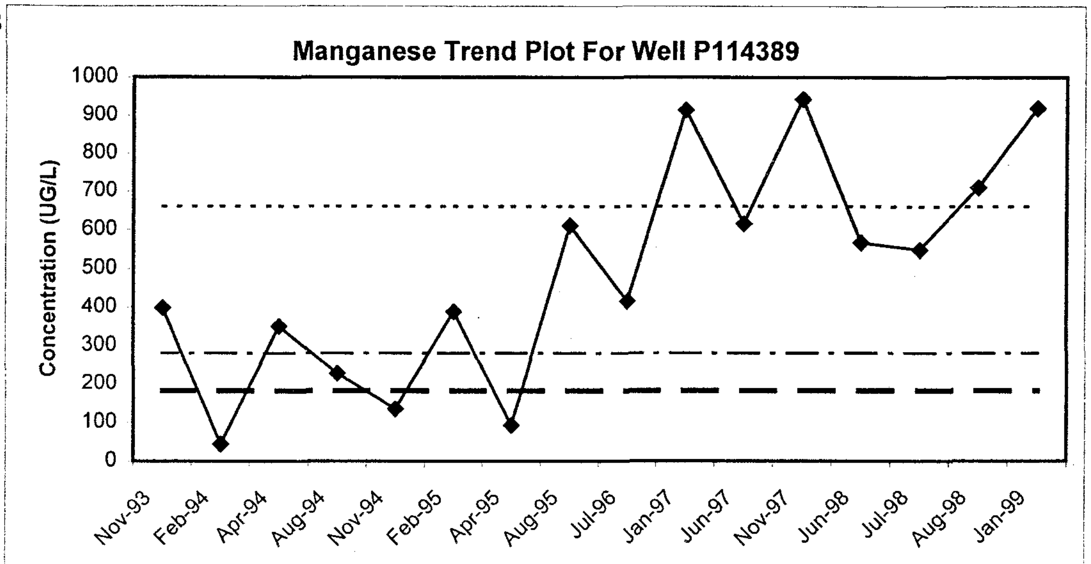


Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

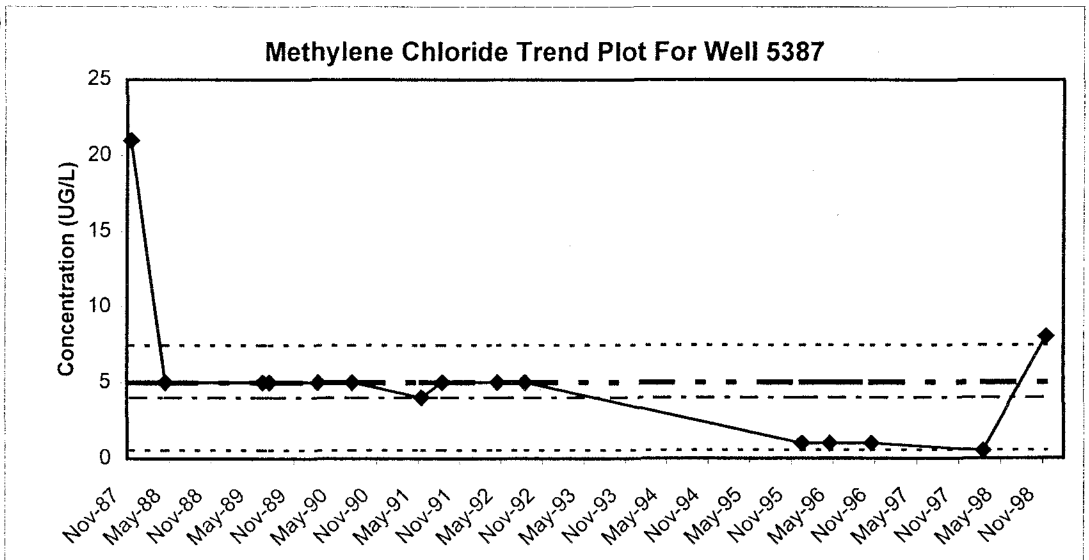
83

Figure 2-1 Through 2-59
Trend Plots For Selected Analytes and Wells

2-58



2-59



Heavy mixed dashed lines = Tier II Action Level
Light uniform dashed lines = Historic +/- Standard Deviations
(-Std. Dev. not shown if <0)
Light mixed dashed lines = Historic Mean

84

2.3.2.2 Drainage Wells

Five Drainage wells, 6486, 6586, 5587, 38591, and 00997, were sampled in 1998. Nickel was reported above the Tier II action level, background M2SD, and historic M2SD for samples collected from wells 6486 and 6586 (Table 2-8). Figures 2-3 and 2-4 show an increasing trend for nickel in wells 6486 and 6586 beginning in the third quarter 1996 and continuing through 1998. As such, nickel in these wells represent reportable values.

According to the IMP, an evaluation of surface water impacts is required at this stage of the process, although the reason for a nickel exceedance at these wells has not been ascertained. At these concentrations, nickel is not known to be a widespread contaminant. The localized nature of nickel at these wells suggest that the high nickel concentrations may be caused by sampling artifacts related to the stainless steel composition of the well casing, changes in sampling procedures, and/or the well geochemical environment. Well sampling techniques at these wells have changed over the past few years, so sampling artifacts caused by changes in purging or sampling technique may explain the high concentrations. Corrosion of well screen (316 stainless steel) and centralizer (304 stainless steel) materials may also be a factor given the fourteen year old age of the wells.

In FY2000, an evaluation of nickel concentrations at wells 6486 and 6586 will be undertaken, including a reexamination of sampling procedures and a downhole television camera survey of well casing and screen conditions to check for corrosion. In addition, a paired PVC Geoprobe well will be installed next to each well and sampled for metals to confirm the presence or absence of nickel in groundwater at these locations. Reproduceable nickel detections above the Tier II action level and historic M2SD concentration at the proposed new well points will then cause the initiation of a surface water impact evaluation developed to investigate the extent of nickel contamination and determine whether nickel represents a potential threat to the surface water quality of Woman Creek. Until the sampling artifact evaluation is completed, these wells will be sampled as part of routine sampling operations.

The uranium isotopes U-233/234 and U-238 were detected above Tier II action levels in four Drainage wells, 00997, 38591, 6486, and 6586. All of the uranium results were below the background benchmarks and, as such, are not reportable values.

2.3.2.3 Performance Monitoring Wells

Performance monitoring wells monitor the effect of a remedial action or source removal on downgradient groundwater quality. As such, contaminant trends over time are the basis for determining reportable values. In considering results for Performance monitoring wells, Tier II action levels and background benchmarks are applied only to determine which analytes are to be monitored using trend charts. Eighteen Performance monitoring wells, including four special groundwater monitoring stations associated with the French Drain (COLWELL and COLGAL), Mound (SW059), and B881 footing drain (SW13494), were sampled in 1998. The wells have been grouped by project to facilitate an interpretation of the results.

Mound

Wells 00897 and 02291 monitor downgradient groundwater quality along the proximal and medial portions of the Mound plume near the site of the former Mound source remediation project. From Table 2-8, the contaminants primarily associated with these wells are PCE, TCE, and possibly methylene chloride. The uranium isotopes U-233/234 and U-238 were detected at above Tier II action levels but below background levels, thus the values do not qualify as reportable results.

Figures 2-5 through 2-7 illustrate the concentration trends of PCE, TCE, and methylene chloride for well 00897 and Figure 2-8 illustrates the PCE concentration trend in well 02291. There was an insufficient number of values to plot methylene chloride for well 00887. Due to the short monitoring period since well 00897 was installed, there is currently an insufficient amount of data to evaluate the trend of PCE and TCE in this well. Some seasonality may be evident in the data with contaminants attaining peak concentrations during the spring months. PCE and TCE in well 02291 indicate erratic, but generally upward, trends that began well before the initiation of source removal activities in 1997. It is expected that the upward trend of these contaminants will eventually reverse and decline as the effects of the Mound source removal are manifested in source area groundwater. Tentatively, the high methylene chloride value (12,000 μg/L) reported for well 00897 is attributed to laboratory contamination that was magnified by dilutions (2,500x) necessary to quantify TCE.

Trench T-3

Wells 11891 and 12191 monitor downgradient groundwater quality associated with the Trench T-3 source remediation project. From Table 2-8, the contaminants primarily associated with these wells are PCE and carbon tetrachloride, with lesser concentrations of TCE. 1,1-Dichloroethene was detected once above the Tier II action level concentration in well 12191, but at a relatively low concentration (7 μg/L) compared to the other VOC contaminants. The uranium isotopes U-233/234 and U-238 were detected at above Tier II action levels but below background levels, thus the values are not considered to be reportable.

For assessing concentration trends, only the major contaminants, PCE and carbon tetrachloride, were selected for trend plotting, as these contaminants are expected to adequately monitor groundwater quality conditions in the vicinity of the trench. The 1998 carbon tetrachloride and PCE results for wells 11891 and 12191, shown in Figures 2-9 through 2-12, are consistent with the historical concentrations of these contaminants, with the possible exception of fourth quarter 1998 PCE in well 11891. Concentration trends for these contaminants are essentially flat and unchanged over time. The significance of the fourth quarter 1998 spike in PCE concentration in well 11891 will be assessed with subsequent data collected during routine groundwater sampling in 1999.

Trench T-4

The potential impact of the Trench T-4 source remediation project on alleviating groundwater contamination is monitored by downgradient Performance monitoring wells 3687, 05691, and 12691. Volatile organic groundwater contamination in well 3687, ranked by Tier II ratios, consists principally of TCE, PCE, and carbon tetrachloride, with lower Tier II ratios of 1,1-dichloroethene, chloroform, and possibly methylene chloride. TCE concentrations consistently exceed Tier I action levels, while PCE and carbon tetrachloride each exhibit single instances of Tier I exceedances. Wells 05691 and 12691 contain basically the same suite of major organic contaminant as well 3687, though in lower concentrations and different proportions. However, detectable concentrations of 1,1-dichloroethene and chloroform above Tier II action levels were not found in either well. A single detection of cis-1,2-dichloroethene was reported for well 12691 at the Tier II action level of 70 μg/L. The uranium isotopes U-233/234 and U-238 were detected at above Tier II action levels but below background levels in all three wells, thus the values are not considered to be reportable.

Based mainly on Tier II ratio rank, trend plots, shown in Figures 2-13 through 2-18, were prepared to evaluate historical groundwater concentration trends at Trench T-4: wells 3687 and 05691 (TCE and carbon tetrachloride), and well 12691 (PCE and carbon tetrachloride). In all plots, the contaminant concentration trends are either flat or slightly declining. Moderate increases in TCE and carbon tetrachloride concentrations are apparent in the fourth quarter 1998 at well 3687, but the presence of similar, possibly seasonal, peaks in both plots suggest that the up turn may only represent a short-term transient effect that is controlled by local hydrologic conditions. The significance of the fourth quarter 1998 spike in TCE and carbon tetrachloride concentrations in well 3687 will be assessed with subsequent data collected during routine groundwater sampling in 1999

French Drain

Performance monitoring wells assigned to the French Drain include downgradient wells 10592, 10692, 10792, 10992, and 11092; the 881 Hillside collection well, 891COLWEL; and the 881 Hillside collection gallery, 891COLGAL. Except for single occurrences of methylene chloride in wells 10592 and 11092, VOCs characteristic of the 881 Hillside groundwater plume (IHSS 119.1), as indicated by the contaminants present in 891COLWEL, were not detected above Tier II action level concentrations in any of the Performance monitoring wells positioned downgradient of the French Drain. VOC contamination above Tier II action levels in 891COLWEL consists mainly of TCE with lower concentrations of PCE, carbon tetrachloride, and possibly methylene chloride. No VOC contamination above Tier II action levels was detected in 891COLGAL.

Selenium was detected above Tier II action levels and background M2SD in wells 10592, 10792, and 10992, with the highest concentrations reported for well 10992 located directly downgradient of the 881 Hillside plume. An above Tier II action level and background M2SD concentration of nitrate/nitrite, an historical 881 Hillside plume contaminant, was detected in only one well, 10992 (nitrate/nitrite is currently not monitored at 891COLWEL and 891COLGAL). 891COLGAL, which comprises all groundwater discharged from the French Drain, contained no detectable VOCs or selenium concentrations above Tier II action levels during 1998. Uranium isotopes U-233/234 and U-238 were detected at above Tier II action levels but below background M2SD levels in all locations except well 11092 (no detections above Tier II action levels), thus the values are not considered to be reportable.

As shown in Figures 2-19 through 2-25, trend plots of representative above Tier II action level contaminants were constructed for wells 10592 and 10792 (selenium), 10992 (selenium and nitrate/nitrite), and 891COLWEL (TCE, PCE, and selenium). Selenium concentrations are historically highest in 891COLWEL located in the center of the 881 Hillside plume. Concentrations in this well rose from about 200 μg/L in 1992 to over 800 μg/L in late 1995 and early 1996, and have steadily fallen back to about 500 μg/L in 1998. When viewed over the long-term, selenium trends in 891COLWEL have remained relatively flat or have slightly increased. Similar trends for TCE and PCE are observed in 891COLWEL, though peak concentrations were attained about one year earlier than for selenium. The selenium trend in well 10592 has steadily declined since concentrations peaked in late 1995 or early 1996, but, over the long term, has returned to concentration levels initially measured in 1993. Selenium trends in well 10992 show a similar decline, while the trend in well 10792 is essentially flat. Nitrate/nitrite in well 10992 also shows a flat to declining trend. Considered collectively, the downgradient well data indicate that contaminants associated with the 881 Hillside plume are not migrating downgradient of the French Drain, and are, therefore, not reportable.

Ryan's Pit

One well, 07391, is designated as a Ryan's Pit plume Performance monitoring well. This well contains some of the highest VOC concentrations ever detected in groundwater at RFETS. TCE is the primary

VOC contaminant, with concentrations attaining a maximum value of 160,000 µg/L during 1998. Other VOCs detected above Tier II action level concentrations include PCE, 1,1,1-trichloroethane, chloroform, and methylene chloride; the latter two contaminants having a questionable presence because both were consistently detected in laboratory blank samples ("B" qualifier). Nitrate/nitrite was detected once above Tier II action levels and background M2SD concentrations, but below historic M2SD concentrations. It is, therefore, not considered to be a reportable occurrence. U-233/234, U-235, and U-238 were all detected at least once above Tier II action levels, with U-238 occurring above background M2SD and historic M2SD activity-concentrations.

Figures 2-26 and 2-27 show that high TCE and PCE concentration conditions persisted throughout 1998. The single instances of above historic M2SD levels reported for each contaminant in the third quarter 1998 are apparently seasonal peaks that are related to major recharge events. In general, TCE and PCE trends do not appear to be increasing, although further monitoring will be required to confirm the presence or absence of an upward trend, especially for PCE. Consequently, the values are not considered to be reportable at this time. In comparison, U-238 activity-concentrations consistently increased during 1998 forming a distinct upward trend above historic M2SD concentrations (Figure 2-28). The combination of abnormally high U-238 activity-concentrations and an upward trend direction represents a reportable occurrence for this analyte. An evaluation to assess the extent of the problem will be initiated during FY2000.

Building 881 Footing Drain Sump

Potential contamination associated with the Building 881 footing drain sump is monitored directly at SW13494 and indirectly by wells 00797 and 5387 (a Plume Extent well). During 1998, organic contamination at SW13494 was distinguished by PCE concentrations that consistently exceeded Tier II action levels, and by a single, suspect methylene chloride value ("B" qualified). VOCs were not detected at downgradient well 00797; however, sulfate was detected above Tier II action levels and background M2SD. Uranium isotopes U-233/234 and U-238 were detected at above Tier II action levels but below background M2SD levels at both locations, thus the values are not considered to be reportable.

Figure 2-29 indicates that PCE concentrations may be increasing at SW13494, although additional data will be required to confirm the upward trend. The significance of this apparent increase will be assessed in future quarterly reports for data collected during 1999. Sulfate in well 00797 was detected at the same concentration (440 mg/L) as last year, but with a sulfate data record consisting of only two values, a trend plot was not constructed for this analyte.

2.3.2.4 Plume Definition Wells

Seventeen Plume Definition wells were monitored during 1998 for the 903 Pad/Ryan's Pit, PU&D Yard, 881 Hillside, IHSS 118.1, and Industrial Area groundwater plumes (Plate 10). As reported in Table 2-8, fifteen of these wells contained at least one or more contaminants that exceeded Tier II action levels, but only well 22896 contained values exceeding Tier I action levels (Tier II ratio greater than or equal to 100). Well 22896 was reclassified as a Plume Definition well in 1998 after unexpectedly high TCE concentrations associated with the Industrial Area VOC plume were detected in 1996 and 1997. This discovery lead to an evaluation, presented in Section 4.1 of this report, of potential impacts to surface water along the northern boundary of the IA VOC plume. TCE concentrations in well 22896 (Figure 2-30) constitute reportable values and prompted an evaluation because this is a new well with no historic baseline.

2.3.2.5 Plume Extent Wells

East Trenches Plume

The East Trenches Plume is monitored by nine Plume Extent wells, including wells 03991, 04091, 04591, 04991, 05091, 06091, 08091, 10194, and 23296. A tenth well, 75992, is located near South Walnut Creek between the known boundaries of the East Trenches and Mound plumes, and is employed to monitor contamination that may originate from either plume. As shown in Plate 10, these wells are located along the outermost edge of the East Trenches plume to monitor plume movement and spreading away from potential source areas, such as Trench T-3, Trench T-4, and the northeast lobe of the 903 Pad VOC plume. VOCs represent the primary constituents of the East Trenches plume.

In previous years, above Tier II action level concentrations of TCE in well 23296 and carbon tetrachloride in well 06091 have triggered monthly confirmation sampling investigations that have verified the presence and concentration of above Tier II contamination in both of these wells. The Site initiated further hydrogeologic and surface water evaluations (DOE, 1998) in 1997 at both locations resulting in the design and installation of a groundwater intercept and treatment system along the upper B-series ponds (Section 6.3 of this report). VOC contamination above Tier II action level concentrations was not detected in any of the three new monitoring wells (02697, 02797, and 02897) installed in the paleochannel downgradient of well 06091, and routine monitoring was resumed at this location (DOE, 1998).

VOC concentrations exceeding Tier II action levels were detected in wells 03991 (carbon tetrachloride, PCE, and TCE); 04991 (methylene chloride and TCE); 06091 (carbon tetrachloride and methylene chloride); 23296 (TCE, cis-1,2-dichloroethene, PCE, and carbon tetrachloride); and 75992 (methylene chloride). Non-radioactive inorganic constituents were not generally detected above Tier II action level concentrations in the East Trenches Plume Extent wells, although isolated instances of nitrate/nitrite in well 06091, selenium in well 10994, and manganese in well 23296 were reported during the year. The uranium isotopes U-233/234 and U-238 were detected at above Tier II action levels but below background levels in all three wells, thus the values are not considered to be reportable. Likewise, strontium-89/90 was detected in well 75992 above the Tier II action level, but below background M2SD activity-concentrations, and is therefore not a reportable value.

Trend plots for carbon tetrachloride (Figure 2-31), PCE (Figure 2-32), and TCE (Figure 2-33) in well 03991 indicate step-like increases in concentration that are probably triggered by major recharge events. For carbon tetrachloride and PCE, concentrations peaked above historic M2SD levels immediately following the spring of 1998 and declined to below historic M2SD concentrations in subsequent sample periods. The net upward trend of these contaminants, as shown by successively higher "steps" in concentration, infer that the East Trenches plume is slowly moving eastward along the buried paleochannel away from source areas. Plume advancement may also be evident at well 04991 (Figure 2-34), located near the southeast boundary of the East Trenches plume, which experienced a sharp rise in TCE concentration (5 μg/L) to the Tier II action level and above historic M2SD concentrations. Conversely, the upward trend in carbon tetrachloride concentration at nearby well 06091, observed during 1996 and 1997, has since leveled off to within the 5 to 6 μg/L range, indicating that plume concentrations in this part of the paleochannel have, at least temporarily, reached an equilibrium condition. Methylene chloride in well 04991 (Figure 2-35) rose above the Tier II action level in 1998, but did not exceed historic M2SD concentrations and is considered to be reportable. In well 06091, monthly confirmation monitoring for methylene chloride (Figure 2-36), together with PCE (Figure 2-37), was initiated in 1999. Monthly confirmation sampling was also initiated in 1999 for nitrate/nitrite (Figure 2-38) in well 06091 and manganese (Figure 2-39) in well 23296. The exceedance values for these wells have been reported in previous quarterly reports.

Wells 03991 and 06091 are located approximately 600 and 200 feet, respectively, from an unnamed, deeply incised gully that receives alluvial seep flow at the terminus of the paleochannel. Groundwater sampling at 04091 in 1998 and 02697 in 1997 failed to detect VOC contamination, thus suggesting that the leading edge of the plume is limited to the vicinity of wells 03991 and 06091. The significance of the Tier II action level TCE detections at well 04991 will be assessed after more data is collected in 1999.

Solar Evaporation Ponds

Plume Extent wells 1386, 1786, 3386, 3586, B208289, B208789, P218389, and P219489 are utilized for monitoring groundwater contamination associated with the Solar Ponds Plume (SPP). The wells are located at the edge of the SPP nitrate plume, which primarily extends north from the Solar Ponds to North Walnut Creek, with additional minor pathways to the east and south toward South Walnut Creek (Plate 7). Nitrate and uranium are the principal contaminants associated with the SPP.

VOCs concentrations exceeding Tier II action levels were detected in wells 1786 (TCE), 3586 (vinyl chloride), and P219489 (methylene chloride). Above Tier II action level concentrations of nitrate/nitrite were found in wells 1786, B208289, P218389, and P219489, all located to the north and east of the Solar Ponds. Metal concentrations above Tier II action levels were detected in wells 1386 (nickel), 1786 (selenium), 3586 (manganese), B208289 (selenium), and B208789 (manganese). The uranium isotopes U-233/234, U-235, and U-238 were detected at above Tier II action levels in various wells, but below background M2SD levels at all locations, and are thus not considered to be reportable.

TCE concentrations at well 1786, shown in Figure 2-40, have historically fluctuated at or below the Tier II action level of 5 μg/L. Based on previous fluctuations, it is suspected that the 6 μg/L TCE detection listed in Table 2-8 represents a temporary condition rather than an significant upward trend in concentration. Routine monitoring for VOCs will continue at this well during 1999 unless further increases in TCE concentration require the initiation of monthly confirmation sampling. Vinyl chloride concentrations at well 3586 (Figure 2-41) have fallen considerably since peaking at over 900 μg/L in 1989. The source of vinyl chloride in well 3586 is attributable to the Mound plume; SPP contaminants such as nitrate and uranium do not appear to be problematical in this well. In 1998, vinyl chloride continued a downward trend, thus eliminating it as a reportable contaminant. Methylene chloride was detected only once above the Tier II action level in well P219489 (Figure 2-42). The "B" qualifier associated with this value indicates that it is potentially caused by a laboratory artifact rather than an actual increase in groundwater contamination at this location.

The concentration of nitrate/nitrite in wells 1786 (Figure 2-43), B208289 (Figure 2-44), P218389 (Figure 2-45), and P219489 (Figure 2-46) has generally remained within their respective historic M2SD ranges. None of the 1998 nitrate/nitrite concentrations in these wells exceeded the historic M2SD concentrations and are, therefore, not reportable.

Nickel concentrations in well 1386 (Figure 2-47) detected during 1998, including values reported for the monthly confirmation samples, remained well above Tier II action level and historic M2SD levels. According to the IMP, an evaluation of surface water impacts is required at this stage of the process, although the reason for a nickel exceedance at this well has not been ascertained. At these concentrations, nickel is not known to be a widespread SPP contaminant, as distinguished by the historical absence of high nickel values in other SPP wells, especially those wells located within the main body of the SPP. The lack of characteristic SPP contaminants, especially nitrate, further clouds the issue. The localized nature of nickel at well 1386, like that found at wells 6486 and 6586, suggests that the high nickel concentrations measured in this well may be caused by sampling artifacts related to the stainless steel composition of the well casing, changes in sampling procedures, and the well geochemical environment.

In FY2000, an evaluation of nickel concentrations at well 1386 will be undertaken, including a reexamination of sampling procedures and a downhole television camera survey of well casing and screen conditions to check for corrosion. In addition, a paired PVC Geoprobe well will be installed next to well 1386 and sampled for metals to confirm the presence or absence of nickel in groundwater at these locations. Reproduceable nickel detections above the Tier II action level and historic M2SD concentration at the proposed new well point will then cause the initiation of a surface water impact evaluation developed to investigate the extent of nickel contamination and determine whether nickel represents a potential threat to the surface water quality of North Walnut Creek.

Selenium is a minor component of the SPP that is often associated with elevated nitrate/nitrite concentrations. The selenium concentrations in well 1786 (Figure 2-48) have trended gradually upward until dropping below historic M2SD concentrations in 1998. Selenium in Well B208289 was detected above the Tier II action level and background M2SD. Because of an insufficient number of values, the historic M2SD contamination is not known, and it was not possible to prepare a trend plot for selenium for this well. Routine monitoring for selenium will continue in this well until a trend direction can be established and evaluated. While selenium has exceeded Tier II action level and historic M2SD concentrations in previous years, it is currently not a reportable contaminant for these two wells based on the concentration levels detected in 1998.

In 1998, manganese concentrations detected in well 3586 (Figure 2-49) were below the historic M2SD and are not considered to be reportable. The manganese concentrations in well B208789 (Figure 2-50) were above the Tier II action level, and reached the historic M2SD concentration of 624 μg/L in the fourth quarter, 1998. Monthly confirmation sampling at this well was started in November 1998 and continued through January 1999. The well B208789 manganese trend plot shows a pronounced steady increase in concentration through 1998, after which the concentration drops to below the Tier II action level concentration in the confirmation samples. The reason for this response is unclear, but does not appear to be related to sampling technique. Routine monitoring will be continued at both wells.

Industrial Area VOC Plume (including IHSS 118.1)

Thirteen Plume Extent wells - 1986, 2186, 6186, 7086, P313589, P314289, P416689, 43392, 10994, 22596, 22696, 22796 and 00197 – are utilized for monitoring groundwater contamination associated with the Industrial Area VOC plume, including IHSS 118.1, a distinctive source of IA VOC contamination. Wells 7086 and 10994 also monitor potential groundwater contamination originating from the Old Landfill located on the hillside below the 400 area building complex north of Woman Creek. As shown on Plate 10, the IA VOC plume spans the middle of the IA in a north-northeast orientation that migrates toward both Woman and North Walnut Creeks. TCE, PCE, and carbon tetrachloride are the primary VOC contaminants; the distribution of which tend to be source-specific and non-uniform. There are no known inorganic or radiological groundwater plumes that coincide with VOC contaminated areas within the IA VOC plume.

Monitoring wells located along the south and east perimeter of the IA VOC plume include 6186, 7086, P313589, P314289, P416689, 43392, 10994, and 00197. No VOCs or water quality parameters above Tier II action levels were detected in any of these wells during 1998. Metals detections above Tier II action levels in these wells consisted of manganese (wells 7086 and P314289), nickel (well P314289), and selenium (well 10994). The uranium isotopes U-233/234 and U-238 were detected at above Tier II action levels in wells 7086, and 10994, but below background M2SD levels at all locations, and are thus not considered to be reportable.

Monitoring wells located along the north perimeter of the IA VOC plume include 1986, 2186, 22596, 22696, and 22796. VOC detections above Tier II action levels in these wells consisted entirely of TCE in wells 1986, 22696, and 22796. Wells 1986 and 22796 also contained consistently high manganese detections, including a single value above the historic M2SD concentration in well 1986. Selenium above the Tier II action level and background M2SD was found in well 10994, but not above historic M2SD concentrations. No water quality parameters were detected above Tier II action levels in any of the north IA Plume Extent wells. The uranium isotopes U-233/234 and U-238 were detected at above Tier II action levels in wells 1986, 2186, and 22796, but below background M2SD levels at all locations, and are thus not considered to be reportable.

The TCE value reported for well 1986 appears to be a spurious result based on the recent below Tier II action level history of this compound presented in Figure 2-51. Considering the fact that previous TCE values in this well have exceeded the upper historic M2SD concentration, the well was kept on a routine monitoring schedule for VOCs rather than initiating a monthly sampling program (RMRS, 1999b). TCE concentrations in wells 22696 and 22796 are presented in Figures 2-52 and 2-53. The TCE concentrations in well 22696, after rising sharply above the Tier II action level in the third quarter of

1998, have fallen to the Tier II action level in a subsequent sample. A declining trend in TCE concentrations is apparent in well 22796. Manganese concentrations in wells 1986, 7086, P314289, and 22796, except for a single value in well 1986 (second quarter of 1998), were below historic M2SD concentrations, and are not considered to be reportable values. Trend plots of manganese concentrations for wells 1986, 7086, and 22796 (Figures 2-54 through 2-56) confirm that the 1998 detections, including the above historic M2SD value in well 1986, do not represent significant increases in concentration over previous monitoring periods. In the case of well P314289, an insufficient number of data points (three) precluded the construction of a manganese trend plot. The same situation exists for nickel at well P314289. Selenium concentrations presented in well 10994 (Figure 2-57) tend to fluctuate about the mean and show no evidence of an increasing trend.

903 Pad/Ryan's Pit VOC Plume

Migration of the 903 Pad/Ryan's Pit VOC plume toward Woman Creek is monitored by Plume Extent wells 23096 and 23196. Plate 10 illustrates the location of these wells in relationship to the distal end of the plume and creek. The plume is mainly composed carbon tetrachloride from the 903 Pad area and TCE from Ryan's Pit. A more complete listing of individual 903 Pad and Ryan's Pit plume contaminants is provided in the discussion of Performance Monitoring and Plume Definition wells presented above.

No VOC or metals contaminants above Tier II action levels were detected in wells 23096 and 23196 during 1998. Nitrate/nitrite was detected once above the Tier II action level and background M2SD in well 23196. No other water quality parameters were detected above Tier II action levels in these wells. The uranium isotopes U-233/234 and U-238 were detected at above Tier II action levels in well 23096, but below background M2SD levels, and thus do not qualify as reportable values.

Nitrate/nitrite in well 23196 was detected just above the Tier II action level at 10.2 μg/L. Monthly confirmation sampling was initiated in September 1998 and completed in November 1998, with the well being dry during the latter two months. The September 1998 nitrate/nitrite concentration was detected below the Tier II action level. This contaminant was absent above the Tier II action level in all 903 Pad/Ryan's Pit Plume Definition wells, including upgradient well 00491. Nitrate/nitrite was detected once above the Tier II action level in Performance monitoring well 07391, but the crossgradient position of this well relative to well 23196 and the absence of VOC contamination in well 23196 makes it highly unlikely that any hydrologic relationship exists between the two wells. Well 23196 was returned to a routine sampling schedule following the conclusion of monthly sampling.

PU&D Yard Plume

Plume Extent wells P114389, 76992, 00397, and 02197 are utilized for monitoring VOC contamination associated with the PU&D Yard, which forms an elongate plume south of the Present Sanitary Landfill that extends from the PU&D Yard on the west to well 02197 on the east. The primary plume contaminants consist of PCE, TCE, and 1,1,1-trichloroethane. Further discussion of PU&D Yard plume contamination is provided in Section 4.2 of this report.

The only constituent found above Tier II action levels in these wells during 1998 was manganese in well P114389. This constituent had exceeded the historic M2SD concentration in 1997 resulting in a round of monthly confirmation sampling from June through August 1998. As shown in Figure 2-58, manganese concentrations in 1998 initially dropped below the historic M2SD value and have since risen above this benchmark continuing an upward trend begun in 1995. The significance of increasing manganese concentrations at well P114389 is unknown, but does not appear to be related to VOC contamination at the PU&D Yard. Manganese is not a PU&D Yard plume contaminant, nor is the well located downgradient of any IHSS or known contaminant source area. The well was returned to a routine sampling schedule based on the results of monthly sampling (2 out of 3 monthly values were below the historic M2SD) (RMRS, 1998b).

881 Hillside Plume

Wells 4787 and 4887 monitor the extent of the 881 Hillside plume. Well 4787 was dry during both semiannual monitoring visits in 1998. Well 4887 was sampled once in 1998, but only a partial sample suite (VOCs and nitrate/nitrite) was collected because of insufficient water conditions. There were no detections of these constituents above Tier II action levels in this well.

Mound Plume

The Mound Plume is monitored by Plume Extent wells 3586 and 75992. Discussion of above Tier II action level concentrations in these wells is contained above within the Solar Evaporation Pond and East Trenches plume extent subsections of this Section. In summary, vinyl chloride (well 3586), methylene chloride (well 75992), manganese (well 3586), uranium-233/234 and uranium-238 (wells 3586 and 75992), and strontium-89/90 were detected above Tier II action levels in 1998, but below background M2SD or historic M2SD concentrations. These detections do not qualify as reportable values under the data quality objective criteria for Plume Extent wells specified in the IMP.

Building 881 Footing Drain Sump

One Plume Extent well, 5387, monitors discharges associated with the Building 881 Footing Drain Sump (SW13494). According to sample results presented for SW13494 (Table 2-8), PCE is the main contaminant of concern in sump water at this locality. PCE was not detected at well 5387 during the 1998 sample visits; however, methylene chloride was detected once above the Tier II action level and historic M2SD benchmark (Figure 2-59). This constitutes a reportable value, but is considered to be suspect because of methylene chloride's reputation as a common laboratory contaminant. The uranium isotopes U-233/234 and U-238 were detected at above Tier II action levels, but below background M2SD levels, and thus do not qualify as reportable values. No metals or water quality constituents were detected above Tier II action levels.

2.3.3 Upgradient Versus Downgradient Well Comparisons

This section contains a discussion and evaluation of RCRA monitoring wells only. D&D monitoring well results are presented by building number in Section 5.0.

RCRA Wells

The Present Sanitary Landfill at RFETS currently operates under CDPHE and EPA guidelines for solid waste disposal sites and facilities. The current groundwater monitoring program was instituted in accordance with the Rocky Flats Cleanup Agreement (RFCA, 1996), and further defined for RCRA units in the IMP. RCRA groundwater monitoring is conducted to detect potential excursions of contamination beyond an established point of compliance based on comparisions of upgradient to downgradient groundwater quality. Under the IMP, if significant impacts to groundwater quality are detected in downgradient RCRA wells and contaminant concentrations are observed to increase with time, then the results are reported to EPA and CDPHE and an investigation into possible causes is initiated. Special attention is given to groundwater contaminants listed in the Action Levels and Standards Framework for Surface Water, Ground Water, and Soils document (RFCA, 1996, Attachment 5), which if exceeded, trigger an evaluation, remedial action, and/or management action. Non-ALF constituents, such as the major cation metals sodium, potassium, calcium, and magnesium, are not reportable under RFCA, and are, therefore, not emphasized in this section. Plate 1 illustrates the location of existing RCRA wells used for monitoring groundwater quality at the Present Sanitary Landfill.

Recent changes to the site groundwater monitoring program are outlined in the IMP (K-H, 1998a). This plan specifies the monitoring and reporting requirements for the Present Sanitary Landfill, including well identification, sampling frequency, analytical requirements, and reporting. Operating procedures are used to specify techniques for sample collection, preservation, shipment, and chain-of-custody control.

For the reporting period, upgradient wells 5887, 70193, 70393, and 70493, and downgradient wells 4087, 52894, and B206989, were sampled on a quarterly basis (January-March, April-June, July-September, and October-December) to determine compliance with RFCA, as set forth in the IMP. Table 2-10 summarizes sampling activities and shows the hydrostratigraphic unit monitored and material screened for all wells sampled in and near the Present Sanitary Landfill in 1998. The limited number and position of these wells makes it infeasible to construct potentiometric surface maps and concentration isopleth maps, thus current and future reports will only assess impacts to or from the landfill at the upgradient and downgradient landfill boundaries.

Groundwater elevations for active wells were measured quarterly as directed in the IMP (K-H, 1998a). Quarterly groundwater samples were analyzed in accordance with Appendix E-2 of the IMP. The absence of complete analyte suites in most quarters for the downgradient wells listed in Table 2-10 is caused by sample volume limitations imposed by slow recharge and/or thin saturation conditions. The alluvium and weathered bedrock at these localities are frequently dry or thinly saturated partly because the dam for the East Landfill Pond acts as a barrier to alluvial groundwater flow from the west, and partly because evapotranspiration demands consume much of the available shallow groundwater in the gulch during the summer months. For this reason, it is normally not possible to collect complete sample sets for each quarterly sampling period.

The assessment of groundwater chemistry at the Present Sanitary Landfill includes an evaluation of the spatial distribution of groundwater constituents in and around the landfill, and a statistical evaluation of the chemistry of downgradient groundwater with respect to upgradient groundwater, as specified in the IMP. Statistical comparisons between downgradient and upgradient groundwater data were made using the methodology described in the *1995 Annual RCRA Groundwater Monitoring Report* (DOE, 1996a).

Compared to the 1997 well data set, the majority of analytes had sufficient data to perform statistical analyses for 1998 largely resulting from a change from semi-annual to quarterly sampling. The quarterly reports contain the analytical results for groundwater samples collected during 1998 (RMRS, 1998a, 1998b, 1999a, and 1999b).

2.3.3.1 Spatial Distribution of Groundwater Constituents

Upgradient Wells

Currently, four wells (5887, 70193, 70393, and 70493) monitor groundwater chemistry in the UHSU immediately upgradient of the Present Sanitary Landfill. Wells 5887 and 70393 are completed in UHSU

Table 2-10
Well Completion Information and Sampling Summary for Present Sanitary Landfill Wells

Well	Hydro-Stratigraphic Unit	Screened Material	Quarterly Sampling Summary			
			Q1	Q2	Q3	Q4
Upgradient Wells						
5887	UPPER	ALLUVIUM	V,W,N,M,T,U	V,W,N,M,T,U	V,W,N,M,T,U	V,W,N,M,T,U
70193	UPPER	BEDROCK	V,W,N,M,T,U	V,W,N,M,T,U	V,W,N,M,T,U	V,W,N,M,T,U
70393	UPPER	ALLUVIUM	V,W,N,M,T,U	V,W,N,M,T,U	V,W,N,M,T,U	V,W,N,M,T,U
70493	UPPER	BEDROCK	V,W,N,M,T,U	V,W,N,M,T,U	V,W,N,M,T,U	V,W,N,M,T,U
Downgradient Wells						
4087	UPPER	ALLUVIUM	V,W,N,M,T,U	V,W,N,M,T,U	V	Dry
52894	UPPER	ALLUVIUM	Dry	V,N,M,T,U	V,W,N,M,T,U	Dry
B206989	UPPER	BEDROCK	V,N,M,T	V,N,T,U	V,N,T	V,M

V = Volatile organic compounds
W = Water quality parameters
N = Nitrate/Nitrite
M = Metals
T = Tritium
U = Uranium isotopes

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alluvial materials and wells 70193 and 70493 are completed in UHSU bedrock. All four wells yielded complete quarterly sample sets for a total of 16 upgradient samples per analyte. The fourth quarter VOC results for wells 5887 and 70393 have been flagged with an "R" data validation qualifier indicating that these results have been rejected and are not reliable.

Concentrations of water quality parameters fall within 0.07 to 0.92 milligrams per liter (mg/L) for fluoride, 0.05 to 5.8 mg/L for nitrate/nitrite, 13 to 48.4 mg/L for sulfate, and 120 to 230 mg/L for TDS. These concentrations occur within the range of background concentrations reported for these analytes in the *1993 Background Geochemical Characterization Report* (DOE, 1993b). A similar situation exists for all of the metal and radionuclide analytes detected in these wells. Except for the major cations (calcium, magnesium, sodium, potassium, and strontium), the concentrations of most metal analytes are reported below the detection limit or as a detectable contaminant in laboratory blank samples ("B" qualified data). Tritium was not detected in any of the upgradient samples, and the uranium isotopes U-233/234, U-235, and U-238, were essentially detected in only two wells (70393 and 70493).

Alluvial well 70393 yielded consistent detections of five chlorinated VOCs, including TCE (24 μg/L maximum), PCE (8 μg/L maximum), carbon tetrachloride (4 μg/L maximum), 1,1,1-TCA (38 μg/L maximum), and 1,1-DCE (20 μg/L maximum), and single detections of methylene chloride (3 μg/L) and cis-1,2-DCE (0.5 μg/L). Weathered bedrock well 70493, paired with well 70393, contained generally lower concentrations and less consistent detections of the type of VOCs found in the overlying alluvium. VOCs found in this well included methylene chloride (7 μg/L maximum), TCE (1 μg/L maximum), PCE (4 μg/L maximum) 1,1,1-TCA (0.8 μg/L maximum), and a single detection of 1,1,1,2-tetrachloroethane (4 μg/L). Alluvial well 5887 contained single detections of methylene chloride (6 μg/L) and TCE (0.7 μg/L) while weathered bedrock well 70193 contained methylene chloride (19 μg/L maximum) and a single detection of PCE (0.6 μg/L). These results are generally consistent with the results of previous monitoring (DOE, 1998b), which determined that the Property Utilization and Disposal (PU&D) Yard was the source of this contamination. Results for all other VOC constituents monitored in upgradient wells were below detection.

Downgradient Wells

Three wells located east of the East Landfill Pond embankment are used to monitor the chemistry of downgradient groundwater in the UHSU (wells 4087, 52894, and B206989). Well B206989 monitors groundwater in the UHSU bedrock and wells 4087 and 52894 monitor the quality of alluvial groundwater. All of the well locations are consistent with 6 CCR 1007-2, which allows alternate placement of monitoring wells downgradient of an interim-status facility where existing physical obstacles prevent installation of wells at the boundary.

Downgradient groundwater quality monitored at wells 4087, 52894, and B206989 appear to show that concentrations of fluoride, nitrate/nitrite, sulfate, total dissolved solids, arsenic, cadmium, chromium, lithium, manganese, selenium, strontium, and zinc exceed upgradient concentrations reported for upgradient wells 5887, 70193, 70393, and 70493. Elevated concentrations of the non-hazardous metals sodium, potassium, calcium, and magnesium were also detected in downgradient wells, but have no ALF groundwater action levels and, consequently, are not discussed. Aluminum, cobalt, molybdenum and nickel were found to have no statistically significant differences (at the 1-percent significance level) in upgradient versus downgradient groundwater quality. The uranium isotopes U-233/234, U-235, and U-238 also appear to have elevated activity-concentrations in downgradient wells compared to upgradient wells. Tritium was reported as being undetected in all upgradient and downgradient wells. All other ALF groundwater constituents in downgradient groundwater, including VOCs, were detected at or below upgradient concentration levels.

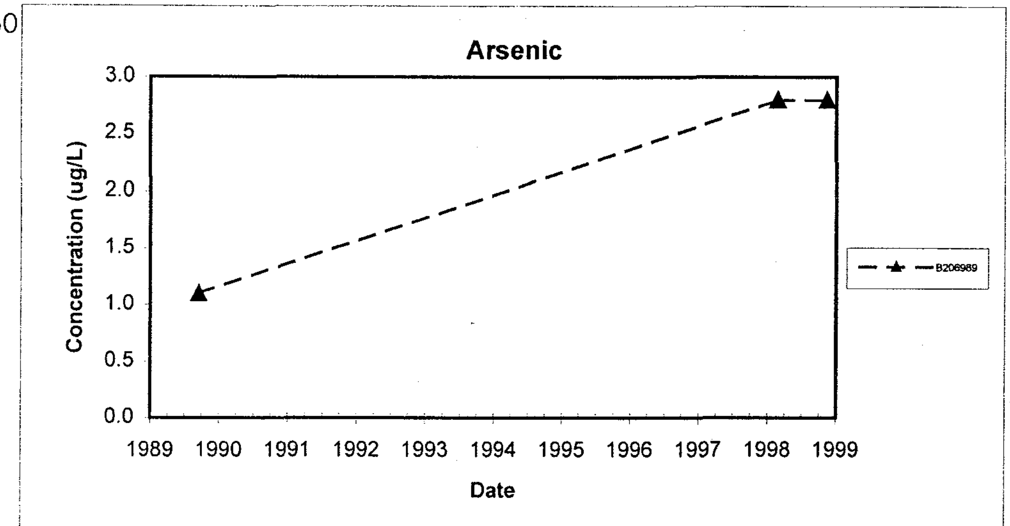
Trend plots of analytes in downgradient wells that exceed upgradient concentrations are presented in Figures 2-60 through 2-75 per the requirements of the IMP. Concentration trends for analytes with three or more data points tend to be somewhat erratic, but are generally flat or declining, and therefore indicate that landfill groundwater is not currently migrating eastward at increased concentrations past the East Landfill dam. Data sets consisting of one or two data points for some analytes are insufficient for discerning trends and can not be interpreted without additional data. These trends will be reevaluated as more data becomes available from the groundwater monitoring program.

Assuming that groundwater seepage past the dam is appreciable enough to influence downgradient groundwater quality, the elevated concentrations of inorganic analytes in downgradient groundwater can be explained by the evaporative concentration of solutes in pond water in combination with other factors, such as mineral build-up in soils resulting from seasonal desaturation of valley-fill alluvial materials and contributions of more highly mineralized groundwater from the underlying LHSU. Analysis of analyte trends showing concentration increases must account for these conditions in order to differentiate between natural and anthropogenic influences. On the other hand, groundwater VOC contributions to pond water will tend to be lost by volatilization before reaching the downgradient wells.

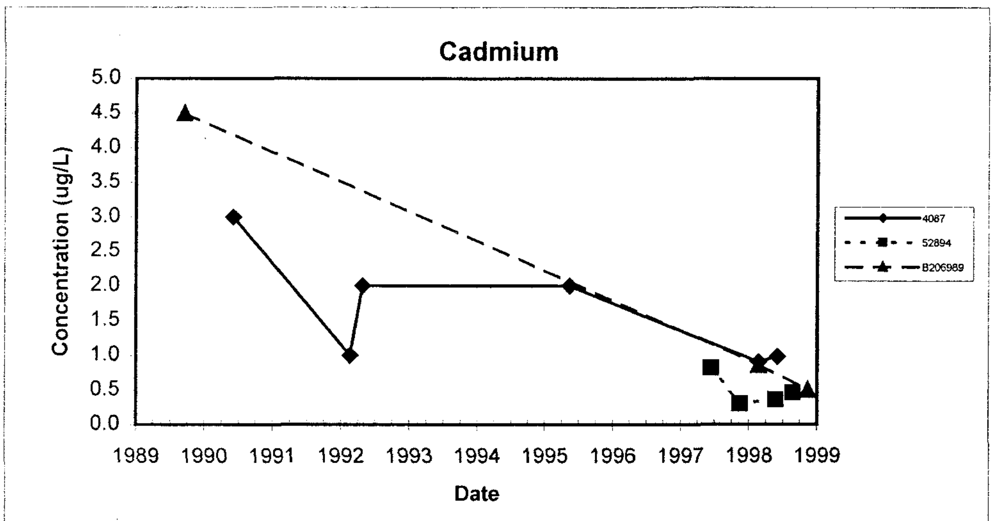
The elevated concentrations of certain inorganic constituents, specifically nitrate/nitrite (NO_3/NO_2), lithium (Li), and selenium (Se) in well B206989, probably indicate the presence of a non-landfill

Figures 2-60 through 2-75
Trend Plots for Selected Analytes-
Downgradient Wells at the Present Sanitary Landfill

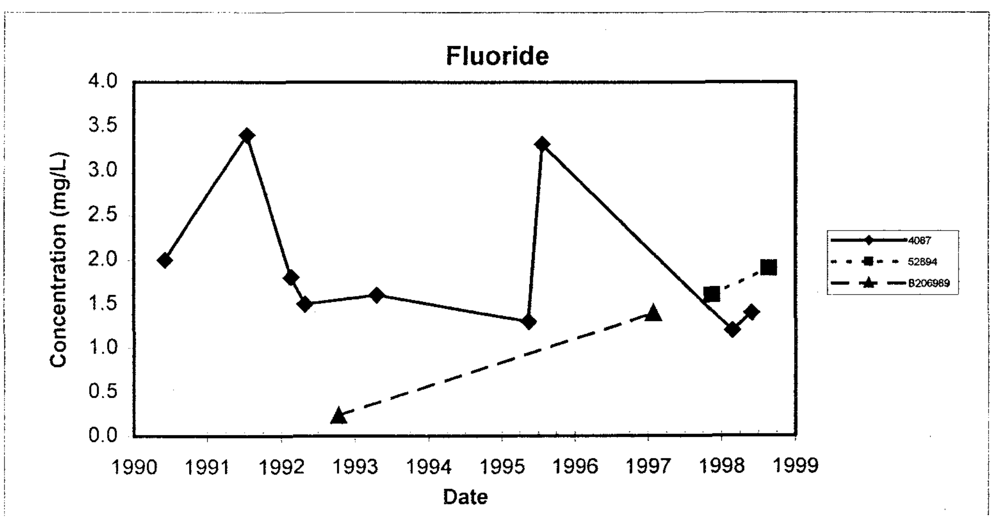
2-60



2-61



2-62



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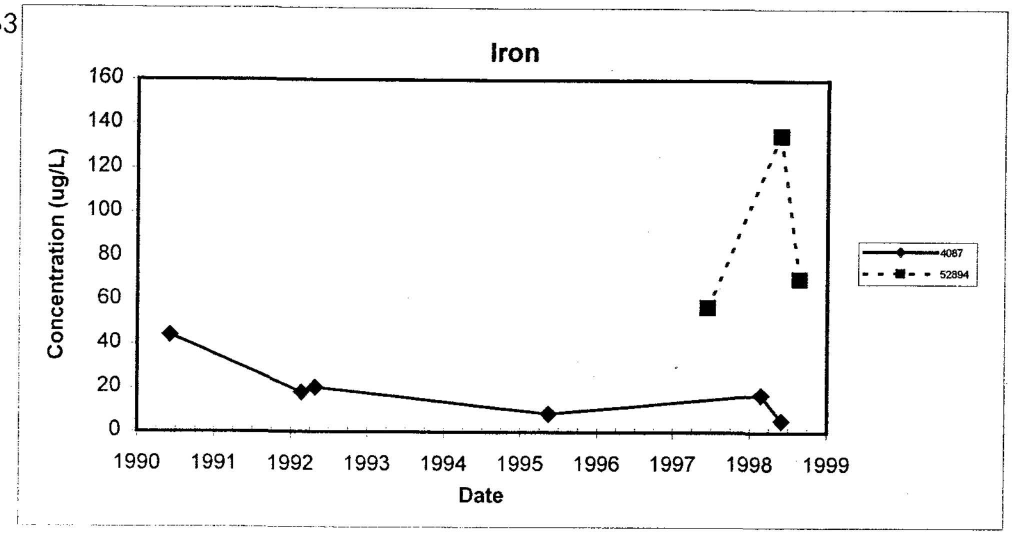
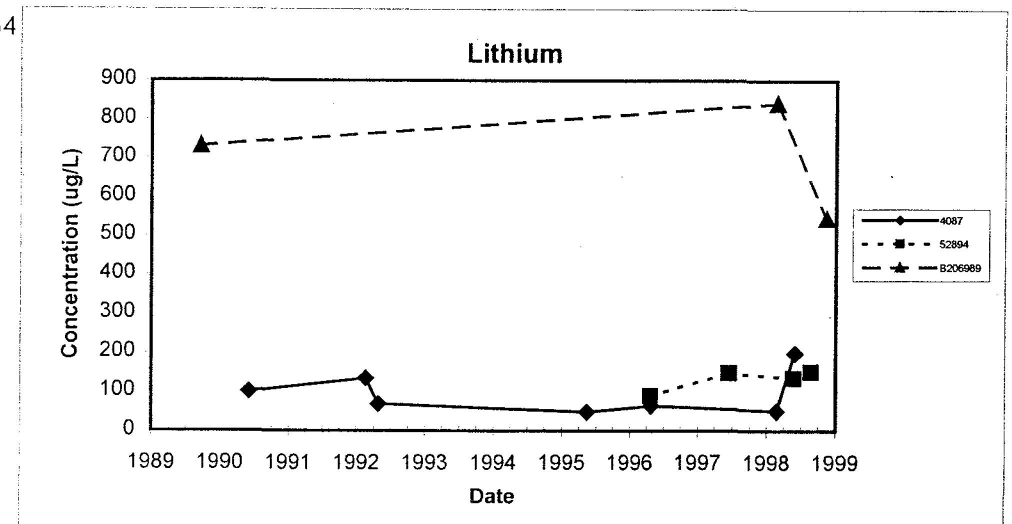
Figures 2-60 through 2-75
Trend Plots for Selected Analytes-
Downgradient Wells at the Present Sanitary Landfill

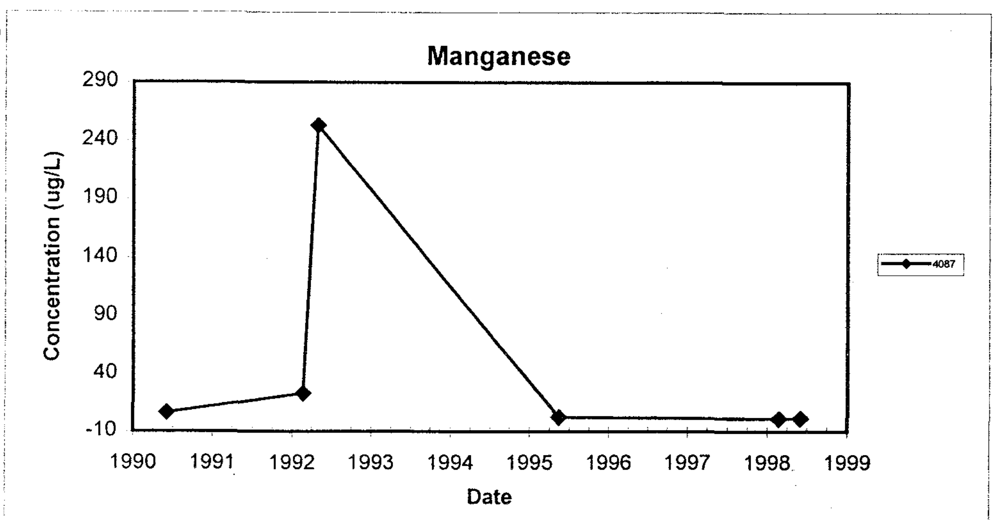
2-63



2-64



2-65



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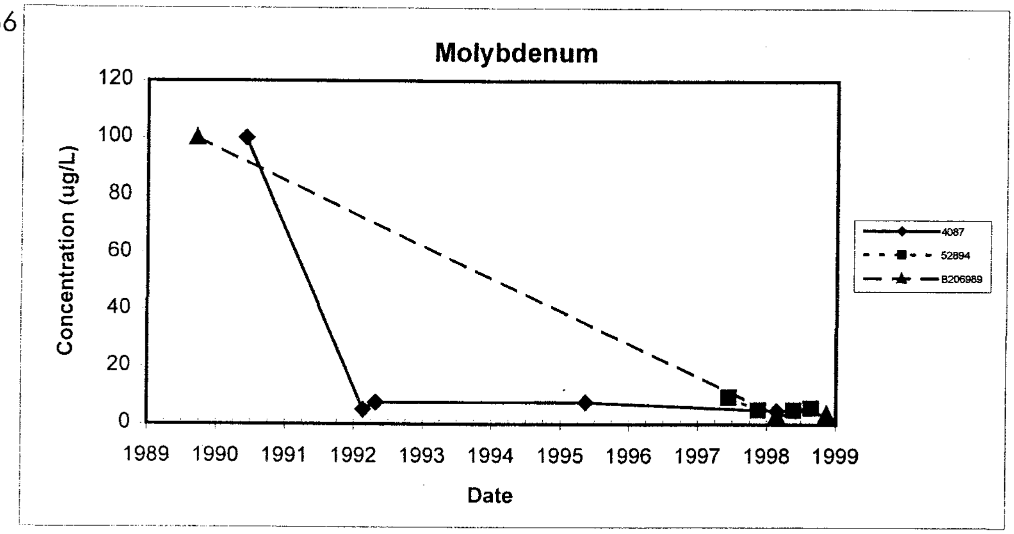
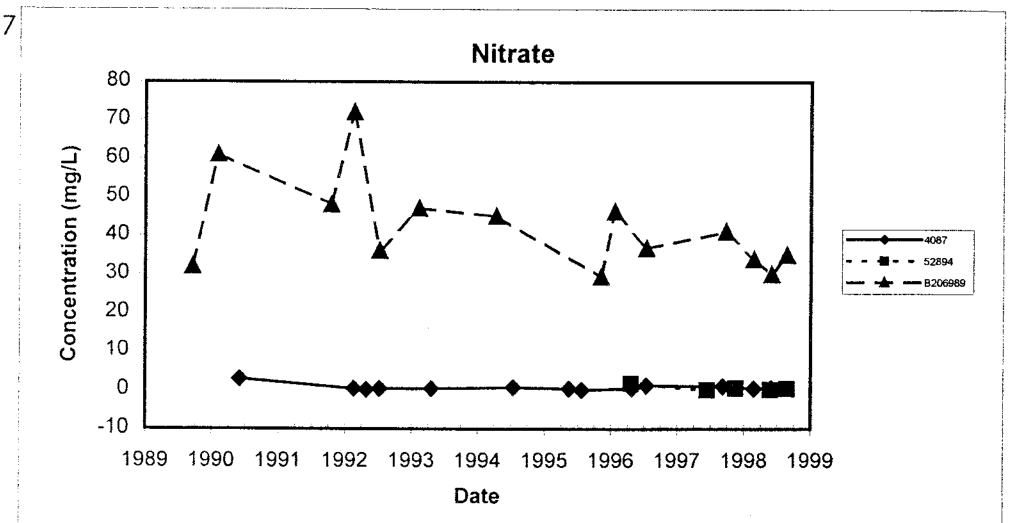
Figures 2-60 through 2-75
Trend Plots for Selected Analytes-
Downgradient Wells at the Present Sanitary Landfill

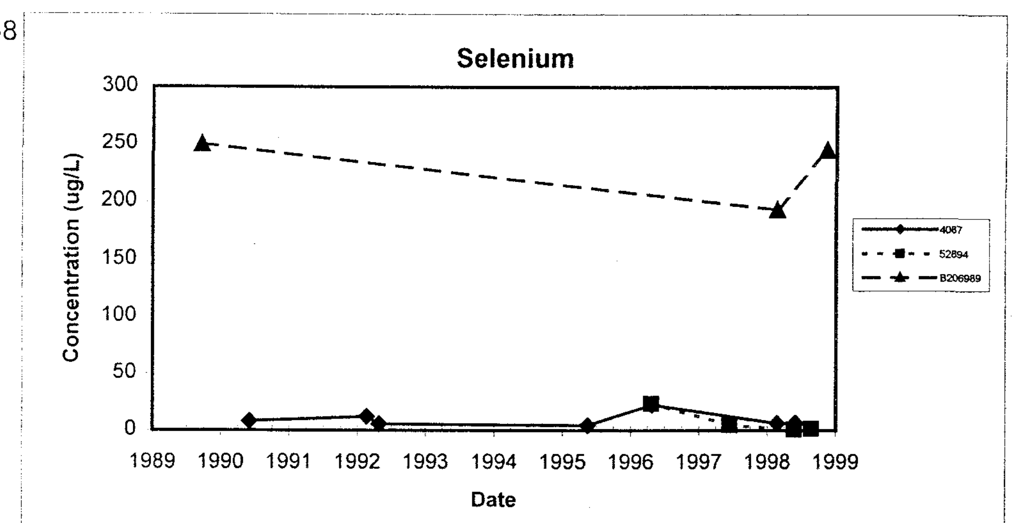
2-66



2-67



2-68



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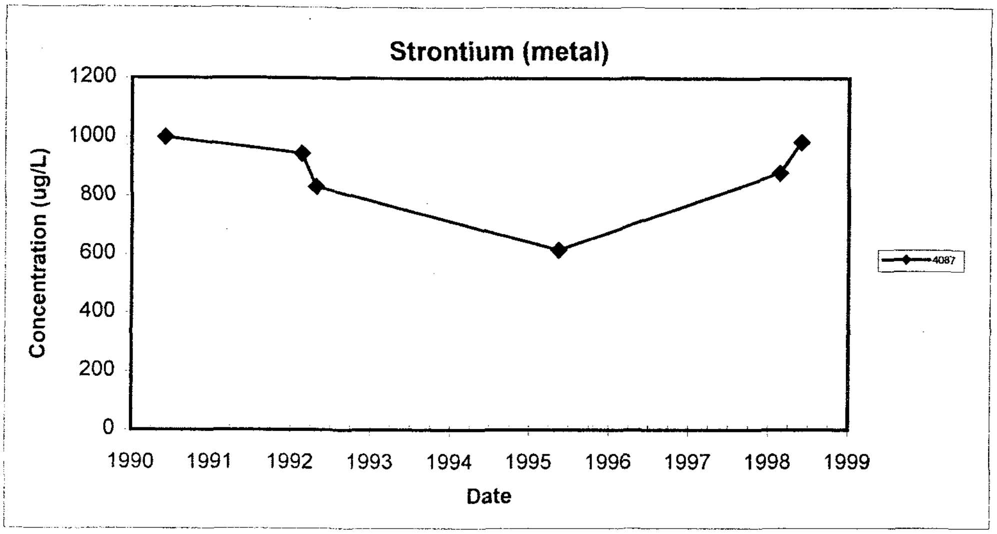
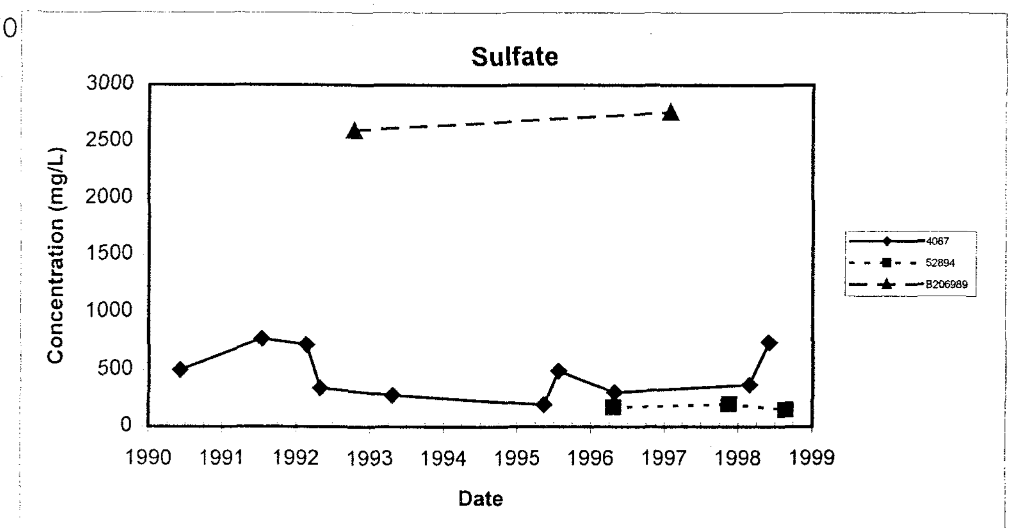
Figures 2-60 through 2-75
Trend Plots for Selected Analytes-
Downgradient Wells at the Present Sanitary Landfill

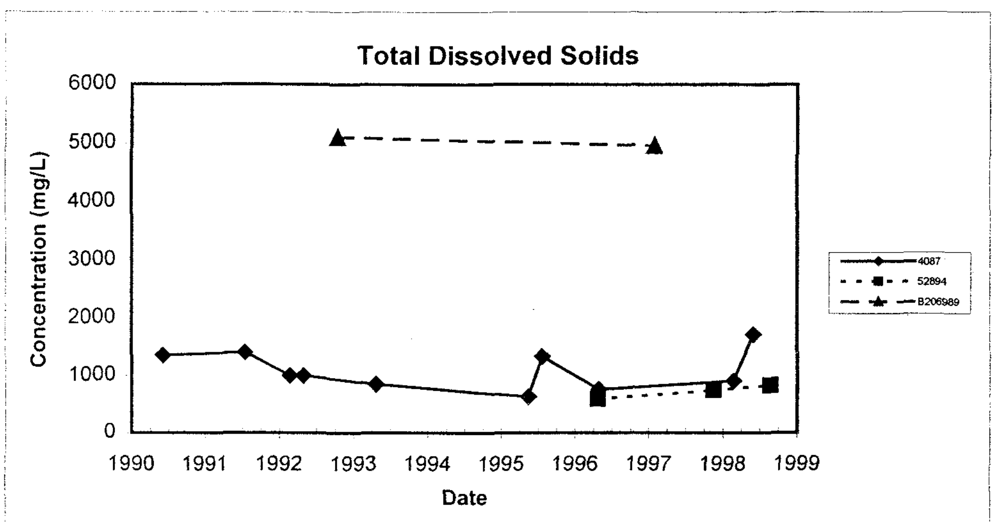
2-69



2-70



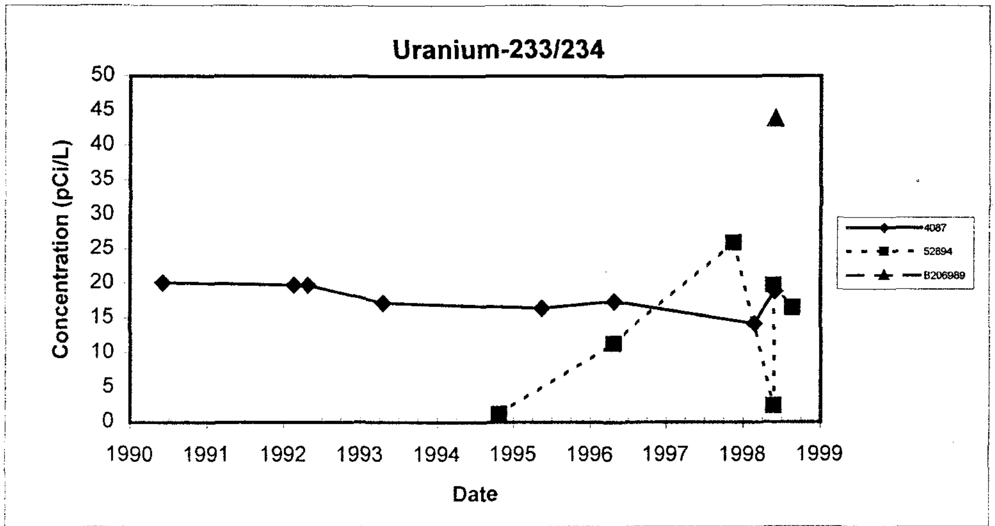
2-71



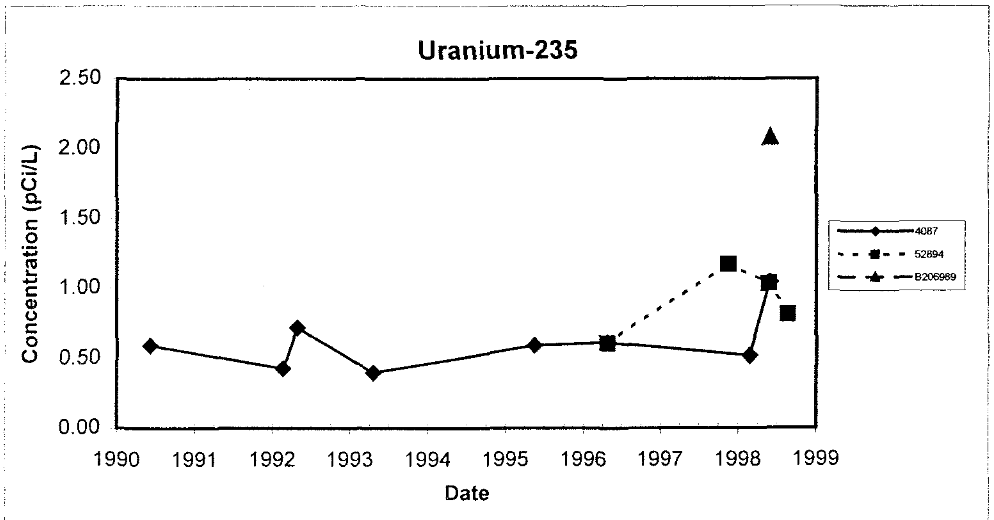
105

Figures 2-60 through 2-75
Trend Plots for Selected Analytes-
Downgradient Wells at the Present Sanitary Landfill

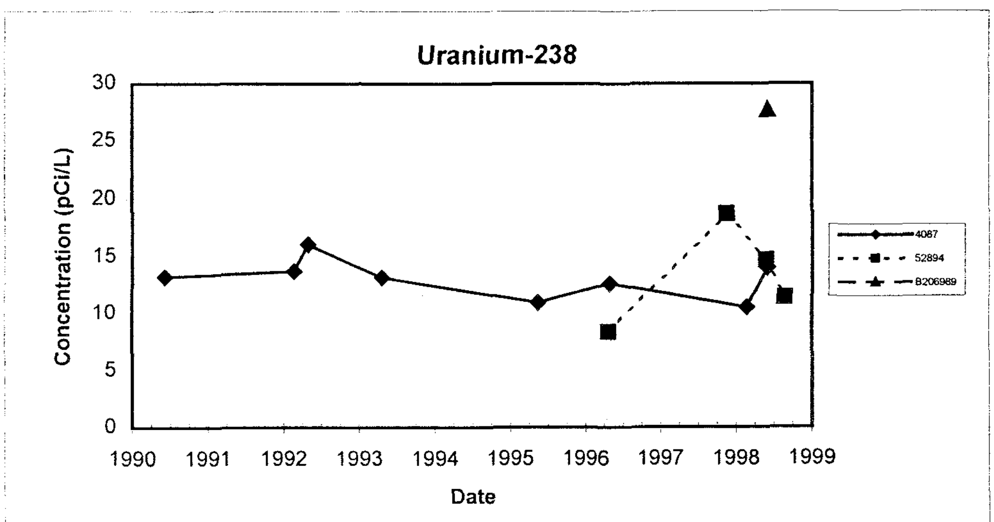
2-72



2-73



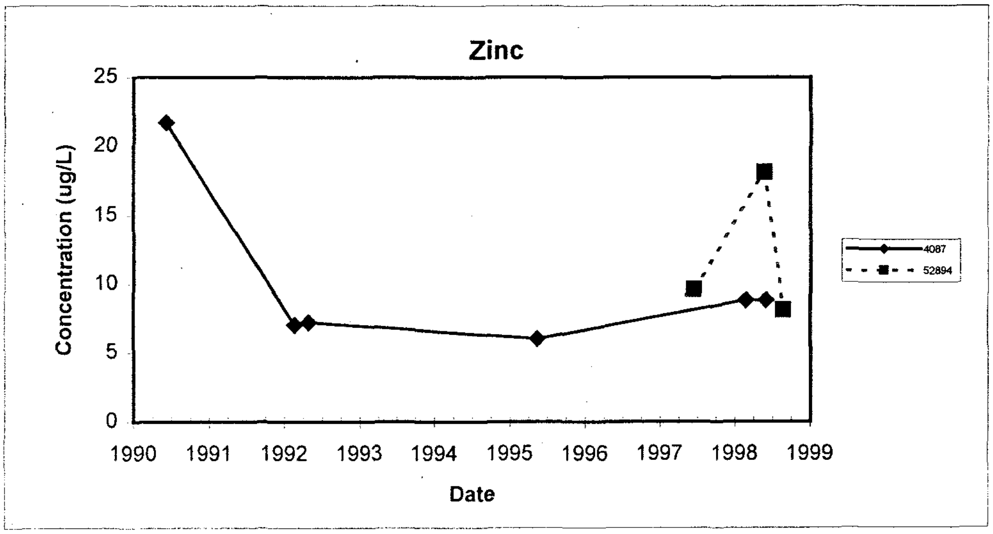
2-74



106

Figures 2-60 through 2-75
Trend Plots for Selected Analytes-
Downgradient Wells at the Present Sanitary Landfill

2-75



/67

contaminant source area that influences downgradient groundwater quality below the landfill pond. This interpretation is supported by the historically low concentration of these analytes in landfill leachate (SW097; mean values = 0.3 mg/L NO_3/NO_2, 40 µg/L Li, and 2 µg/L Se) and landfill pond water (SW098; mean values = 0.093 mg/L NO_3/NO_2 and 77 µg/L Li) (DOE, 1996a, Tables 2-2 and 2-3), and elevated concentration of nitrate/nitrite (mean=143.5 mg/L), lithium (199 µg/L) and selenium (504 µg/L) in samples from UHSU bedrock well B206889, located to the south and upgradient of well B206989. Potential source areas for these contaminants are currently unknown. Regardless of the source of these contaminants, their absence at high concentrations in landfill groundwater and surface water indicate the presence of potential non-landfill interferences in interpreting downgradient weathered bedrock groundwater quality.

2.3.3.2 Statistical Evaluation of Groundwater Constituents

Where possible, analytical data for groundwater monitored upgradient of the Present Sanitary Landfill were compared statistically to analytical data for groundwater sampled from compliance-boundary wells located downgradient of the Present Sanitary Landfill. Results of these comparisons were used to evaluate potential contaminant releases from the regulated unit into the uppermost "aquifer". The comparisons between upgradient and downgradient groundwater quality were made using the statistical methodology discussed in the 1995 Annual RCRA Report (DOE, 1996a). Table 2-11 presents a sampling and detection summary for each groundwater analyte monitored during 1998. Statistical comparisons were not performed for analytes with less than 50-percent quantifiable results or for analytes with less than two quantifiable results. For analytes involving nonparametric analysis, the minimum sample volume requirement of at least two quantifiable results per group was increased to four as recommended by EPA guidance (EPA, 1992b). A sufficient number of samples were collected from upgradient and downgradient well groups to perform statistical comparisons for all analytes with more than 50-percent quantifiable results, except sulfate and total dissolved solids (3 downgradient samples each). Data for volatile organic compounds (except methylene chloride), nine trace metals (arsenic, beryllium, cobalt, lead, mercury, silver, thallium, tin, and vanadium), tritium, and uranium-235 met the sample volume criteria, but non-detections exceeded 50 percent of the data sets, so it was necessary to exclude these compounds from statistical evaluation. Conclusions concerning these analytes are described following the discussion of statistical comparisons.

Table 2-11 Groundwater Sample and Detection Summary for Present Sanitary Landfill Wells

Parameter	Number of Samples			Number of Detections			Percent Detections			Percent Non-Detects
	Upgradient	Down-gradient	Total	Upgradient	Down-gradient	Total	Upgradient	Down-gradient	Total	
Water Quality (mg/L)										
Fluoride	16	3	19	16	3	19	100.0	100.0	100.0	0.0
Nitrate/Nitrite	16	6	22	15	5	20	93.8	83.3	90.9	9.1
Sulfate	16	3	19	16	3	19	100.0	100.0	100.0	0.0
Total Dissolved Solids	16	3	19	16	3	19	100.0	100.0	100.0	0.0
Metals (ug/L)										
Aluminum	16	6	22	15	5	20	93.8	83.3	90.9	9.1
Antimony	16	6	22	9	3	12	56.3	50.0	54.5	45.5
Arsenic	16	6	22	1	4	5	6.3	66.7	22.7	77.3
Barium	16	6	22	16	6	22	100.0	100.0	100.0	0.0
Beryllium	16	6	22	2	1	3	12.5	16.7	13.6	86.4
Cadmium	16	6	22	8	5	13	50.0	83.3	59.1	40.9
Calcium	16	6	22	16	6	22	100.0	100.0	100.0	0.0
Chromium	16	6	22	12	3	15	75.0	50.0	68.2	31.8
Cobalt	16	6	22	2	3	5	12.5	50.0	22.7	77.3
Copper	16	6	22	13	6	19	81.3	100.0	86.4	13.6
Iron	16	6	22	9	3	12	56.3	50.0	54.5	45.5
Lead	16	6	22	6	2	8	37.5	33.3	36.4	63.6
Lithium	16	6	22	16	6	22	100.0	100.0	100.0	0.0
Magnesium	16	6	22	16	6	22	100.0	100.0	100.0	0.0
Manganese	16	6	22	15	4	19	93.8	66.7	86.4	13.6
Mercury	16	6	22	1	0	1	6.3	0.0	4.5	95.5
Molybdenum	16	6	22	8	6	14	50.0	100.0	63.6	36.4
Nickel	16	6	22	12	6	18	75.0	100.0	81.8	18.2
Potassium	16	6	22	16	6	22	100.0	100.0	100.0	0.0
Selenium	16	6	22	9	6	15	56.3	100.0	68.2	31.8
Silver	16	6	22	4	1	5	25.0	16.7	22.7	77.3
Sodium	16	6	22	16	6	22	100.0	100.0	100.0	0.0
Strontium	16	6	22	16	6	22	100.0	100.0	100.0	0.0
Thallium	16	6	22	6	2	8	37.5	33.3	36.4	63.6
Tin	16	6	22	1	2	3	6.3	33.3	13.6	86.4
Vanadium	16	6	22	4	2	6	25.0	33.3	27.3	72.7
Zinc	16	6	22	16	6	22	100.0	100.0	100.0	0.0
Radionuclides (pCi/L)										
Tritium	16	7	23	4	2	6	25.0	28.6	26.1	73.9
U-233/234	16	5	21	7	5	12	43.8	100.0	57.1	42.9
U-235	16	5	21	3	5	8	18.8	100.0	38.1	61.9
U-238	16	5	21	8	5	13	50.0	100.0	61.9	38.1
Volatile Organic Compounds (ug/L)										
1,1,1,2-Tetrachloroethane	16	9	25	1	0	1	6.3	0.0	4.0	96.0
1,1,1-Trichloroethane	16	9	25	6	0	6	37.5	0.0	24.0	76.0
1,1,2,2-Tetrachloroethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,1,2-Trichloroethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,1-Dichloroethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,1-Dichloroethene	16	9	25	4	0	4	25.0	0.0	16.0	84.0
1,1-Dichloropropene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,2,3-Trichlorobenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,2,3-Trichloropropane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,2,4-Trichlorobenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,2,4-Trimethylbenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0

Table 2-11 Groundwater Sample and Detection Summary for Present Sanitary Landfill Wells

Parameter	Number of Samples			Number of Detections			Percent Detections			Percent Non-Detects
	Upgradient	Down-gradient	Total	Upgradient	Down-gradient	Total	Upgradient	Down-gradient	Total	
1,2-Dibromo-3-chloropropane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,2-Dibromoethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,2-Dichlorobenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,2-Dichloroethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,2-Dichloropropane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,3,5-Trimethylbenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,3-Dichlorobenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,3-Dichloropropane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
1,4-Dichlorobenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
2,2-Dichloropropane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Benzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Bromobenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Bromochloromethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Bromodichloromethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Bromoform	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Bromomethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Carbon Tetrachloride	16	9	25	4	0	4	25.0	0.0	16.0	84.0
Chlorobenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Chloroethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Chloroform	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Chloromethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
cis-1,2-Dichloroethene	16	9	25	1	0	1	6.3	0.0	4.0	96.0
cis-1,3-Dichloropropene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Dibromochloromethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Dibromomethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Dichlorodifluoromethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Ethylbenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Hexachlorobutadiene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Isopropylbenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
m/p-Xylene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Methylene Chloride	16	9	25	9	5	14	56.3	55.6	56.0	44.0
Naphthalene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
n-Butylbenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
n-Propylbenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
o-Chlorotoluene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
o-Xylene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
p-Chlorotoluene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
p-Isopropyltoluene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
sec-Butylbenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Styrene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
tert-Butylbenzene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Tetrachloroethene	16	9	25	7	0	7	43.8	0.0	28.0	72.0
Toluene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
trans-1,2-Dichloroethene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
trans-1,3-Dichloropropene	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Trichloroethene	16	9	25	7	0	7	43.8	0.0	28.0	72.0
Trichlorofluoromethane	16	9	25	0	0	0	0.0	0.0	0.0	100.0
Vinyl Chloride	16	9	25	0	0	0	0.0	0.0	0.0	100.0

For analytes with greater than 50-percent quantifiable results, parametric ANOVA or nonparametric Wilcoxon Rank-Sum testing was performed, depending on the percentage of non-detections present in the sample groups and sample distribution characteristics. All UHSU results (alluvial and bedrock) were grouped by analyte into upgradient and downgradient data sets to simplify analyses and provide adequate data to perform statistical testing. This approach is justifiable because all downgradient wells are closely located in a well-defined, narrow drainage way that defines the sole groundwater flow path leading from the landfill. The Wilcoxon Rank-Sum test (also known as the Mann-Whitney U test) was selected to perform nonparametric comparisons in place of the Kruskall-Wallis test based on EPA guidance for statistical evaluations involving two data groups (EPA, 1992b).

Table 2-12 summarizes the results of statistical comparisons for the upgradient and downgradient data groups. Statistically significant differences (at the 1-percent significance level) in upgradient versus downgradient groundwater quality were found for fluoride, cadmium, calcium, lithium, magnesium, molybdenum, potassium, sodium, strontium, U-233/234, and U-238. With the exception of cadmium and molybdenum, these results are similar those reported in previous RCRA reports.

Of the nine trace metals reported with non-detections exceeding 50 percent sample set, only arsenic in well B206989 appears to be elevated above upgradient groundwater concentrations. The elevated concentration of this analyte in well B206989, as also observed for nitrate/nitrite, lithium, and selenium in this well, may signify an association with a contaminant source other than the landfill. The elevated activity-concentration of U-235 in this well compared to the other downgradient wells and upgradient wells could result from either natural sources present within the bedrock, as it occurs within the background range for this isotope (DOE, 1993b; Table D-9), or alternatively, from the unknown source tentatively implicated to explain the elevated concentrations for nitrate/nitrite, lithium, and selenium.

2.4 Discussion of Groundwater Plumes

Plume maps have been updated using 1998 data for composite VOCs (TCE, PCE, vinyl chloride, and carbon tetrachloride) and dissolved nitrate. Groundwater chemistry data extracted from the SWD were used in constructing these maps. All monitoring wells with analytical results for the years 1991 through 1998, regardless of the number of samples collected during that time, were used to produce the plume maps. The maps consist of data compiled from approximately 600 wells. Chemical data were prepared using the methods specified in Section 2.1. The mean concentration of each analyte for each well from 1991 through 1998 was calculated and plotted. Results below the CRDL were identified in the data as

Table 2-12 Comparative Statistics for Groundwater Analytes with <50 Percent Sample Non-Detections
Present Sanitary Landfill

Parameter	Percent Non-Detects	Shapiro-Wilk Normality Test				Levene Test				Parametric ANOVA (Single Factor)				Wilcoxon Rank-Sum Test			
		W_x	$W_{Ln\,x}$	$W_{n,0.05}$	Distribution Type	F_z	$F_{Ln\,z}$	$F_{.05}$	Variances Equal?	F_x	$F_{Ln\,x}$	$F_{.05}$	Significant Difference?[1]	W	Z	$Z_{.01}$	Significant Difference?[1]
Water Quality																	
Fluoride	***0***	***0.766***	***0.964***	***0.901***	***Log Normal***		**3.549**	**4.451**	**Yes**		**18.841**	**4.451**	**Yes**	**N/A**	**N/A**	**N/A**	**N/A**
Nitrate/Nitrite	9.1	0.488	0.859	0.911	Unknown				Unknown					35.5	-0.962	2.326	No
Sulfate	0	0.455	0.751	0.901	Unknown				Unknown					*	*	*	*
TDS	0	0.522	0.693	0.901	Unknown				Unknown					*	*	*	*
Metals																	
Aluminum	9	0.934	0.884	0.911	Normal	1.377		4.351	Yes		2.033	4.351	No	N/A	N/A	N/A	N/A
Antimony	45.5	N/A	N/A	N/A	Unknown				Unknown					45	-0.261	2.326	No
Barium	0	0.920	0.812	0.911	Normal	11.386		4.351	No	N/A		4.351	N/A	23.5	-1.844	2.326	No
Cadmium	**40.9**	**N/A**	**N/A**	**N/A**	**Unknown**				**Unknown**					**80**	**2.337**	**2.326**	**Yes**
Calcium	**0**	**0.462**	**0.714**	**0.911**	**Unknown**				**Unknown**					**96**	**3.504**	**2.326**	**Yes**
Chromium	31.8	N/A	N/A	N/A	Unknown				Unknown					56.5	0.591	2.326	No
Copper	13.6	0.818	0.916	0.911	Log Normal		8.103	4.351	No		N/A	4.351	N/A	75	1.957	2.326	No
Iron	45.5	N/A	N/A	N/A	Unknown				Unknown					51.5	0.223	2.326	No
Lithium	**0**	**0.501**	**0.895**	**0.911**	**Unknown**				**Unknown**					**96**	**3.502**	**2.326**	**Yes**
Magnesium	**0**	**0.467**	**0.742**	**0.911**	**Unknown**				**Unknown**					**96**	**3.503**	**2.326**	**Yes**
Manganese	13.6	0.418	0.818	0.911	Unknown				Unknown					50	0.111	2.326	No
Molybdenum	**36.4**	**N/A**	**N/A**	**N/A**	**Unknown**				**Unknown**					**96**	**3.525**	**2.326**	**Yes**
Nickel	18.2	N/A	N/A	N/A	Unknown				Unknown					80	2.325	2.326	No
Potassium	**0**	**0.433**	**0.800**	**0.911**	**Unknown**				**Unknown**					**96**	**3.503**	**2.326**	**Yes**
Selenium	31.8	N/A	N/A	N/A	Unknown				Unknown					70.5	1.625	2.326	No
Sodium	**0**	**0.576**	**0.750**	**0.911**	**Unknown**				**Unknown**					**96**	**3.502**	**2.326**	**Yes**
Strontium	**0**	**0.453**	**0.775**	**0.911**	**Unknown**				**Unknown**					**96**	**3.504**	**2.326**	**Yes**
Zinc	0	0.733	0.902	0.911	Unknown				Unknown					62	0.996	2.326	No
Radionuclides																	
U-233/234	**42.8**	**N/A**	**N/A**	**N/A**	**Unknown**				**Unknown**					**80**	**3.262**	**2.326**	**Yes**
U-238	**38.1**	**N/A**	**N/A**	**N/A**	**Unknown**				**Unknown**					**80**	**3.263**	**2.326**	**Yes**
VOCs																	
Methylene Chlorid	44.0	N/A	N/A	N/A	Unknown				Unknown					60	-0.720	2.326	No

* Insufficient number of downgradient sample results to perform analysis
N/A = not applicable
[1] Significant difference in downgradient to upgradient sample groups shown in bold typeface

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"U" qualified. U-qualified data were given values of one-half the reported CRDL. VOCs have action levels low enough that the variation in CRDLs from one laboratory to another has caused some averages from wells with predominantly non-detect results to be above the Tier II action levels. The CRDLs exhibited the greatest variation for VOCs as a result of sample dilution reruns. For VOCs only, any CRDLs above 1 microgram per liter (μg/L) was adjusted to 1 μg/L, and the average was calculated using one-half the adjusted CRDL.

It should be noted that the term "plume map" is used here to delineate potential areas of elevated contaminant concentrations derived from each data set. In fact the map for a particular analyte may not show a plume at all, but rather just the distribution of the historical average chemical data results for that analyte. Because of assumptions made during data reduction, it is expected that these maps may contain a limited number of false values above Tier II action levels. Plume boundaries, where drawn, represent the best estimates of the spatial distribution of concentrations of selected chemicals of concern in groundwater at RFETS.

2.4.1 Volatile Organic Compound Plumes

Plate 10 presents a composite of four common VOC contaminants – TCE, PCE, vinyl chloride and carbon tetrachloride – which typify the type of VOC contamination found in general at RFETS. The map shows the estimated extent of Tier I (200 μg/L for vinyl chloride and 500 μg/L for TCE, PCE, and carbon tetrachloride) and Tier II (2 μg/L for vinyl chloride and 5 μg/L for TCE, PCE, and carbon tetrachloride) groundwater VOC contamination based on data collected during the period 1991 to 1998. Individual plume maps for these VOC contaminants were presented in the 1997 Annual RFCA Groundwater Monitoring Report (DOE, 1998), and should be consulted when examining VOC associations with specific source areas.

The VOC plume map has been updated from those published in previous Annual RFCA Groundwater Monitoring Reports (RMRS, 1997b and 1998) to reflect new data collected in 1998. The main area of change involved extending the Tier I and Tier II boundaries from the IA plume westward toward the unnamed drainage that separates the 700 area from Building 371/374. This change incorporates new VOC data collected from well points installed in 1998 for the northern IA plume evaluation (see Section 4.1). The Mound plume boundary was also broadened slightly to account for above Tier I action level TCE concentrations detected at well 00897. Refinements to the Tier II boundary were made at the leading edge of the 903 Pad/Ryan's Pit plume near the South Interceptor Ditch at Pond C-1, and along the east boundary of the IA plume near Building 779. The 903 Pad/Ryan's Pit plume boundary was redrawn to more accurately reflect the extent of VOCs found in the 1998 well points, which resulted in a retraction away from wells 2987 and 23196. The absence of VOCs above Tier II action levels in the Building 779 D&D wells (02297, 02397, and 02497) caused the IA Tier II boundary to be redrawn west of Building 779, thus resulting in a minor retraction of the boundary at Buildings 707 and 777. A small area of Tier II VOC contamination centered around D&D monitoring well 10498, located downgradient of Building 123, was also added to the map.

In 1999, an evaluation of the eastern boundary of the IA VOC plume was implemented to better define the extent of VOC contamination east of the Eighth Street utility corridor and upgradient of Buildings 707, 776, 778, 883, and 865. The proposed field investigation involves the installation and sampling of 15 small diameter wells along Eighth Street between Building 881 on the south and Building 771 on the north. Details of this investigation are specified in RMRS (1999c). The results of this investigation will be reported in the 1999 Annual RFCA Groundwater Monitoring Report .

2.4.2 Nitrate Plumes

The nitrate plume map has been updated slightly from those published in previous Annual RFCA Groundwater Monitoring Reports (RMRS, 1997b and 1998) to reflect new data collected in 1998. Plate 7 shows the estimated extent of Tier I (1,000 mg/L) and Tier II (10 mg/L) groundwater nitrate contamination based on data collected from the period 1991 to 1998. For reference, the background concentration for nitrate in groundwater at RFETS is 4.7 mg/L (DOE, 1993b).

Plate 7 illustrates one major nitrate plume (Solar Ponds Plume) and four minor areas. The Solar Ponds Plume (SPP) is located in the northeast portion of the PA and extends from the Solar Evaporation Ponds to the northeast towards North Walnut Creek. All values of nitrate over the Tier I action level are associated with this plume. The four minor areas of nitrate concentration above the Tier II action level are associated with the Old Landfill, the 903 and 904 Pads, IHSS 119.1 on the 881 Hillside, and an area west of the Present Sanitary Landfill Pond. Scattered occurrences of nitrate above the Tier II action level are also found at well 08391 (444 mg/L), located approximately 1200 feet east of the IA; wells 3386 (12.4 mg/L) and 22896 (12.1. mg/L) in the PA; well 00597 (10.1 mg/L) at the south perimeter of the Present Sanitary Landfill; and well 10498 (26 mg/L) downgradient of Building 123. The only significant change in nitrate plume extent involved extending the SPP Tier II boundary westward to encompass Buildings 774 and 779, and the eastern one third of Building 777. This change is based on consideration of historical nitrate data from building foundation drains available for PA Buildings 707, 771, 774, and 779 (DOE, 1994a) and new nitrate data from North IA well points installed in 1998 (see Section 4.1).

3.0 GROUNDWATER FLOW CONDITIONS DURING 1998

Groundwater level data collected throughout calendar year 1998 were reviewed to determine whether significant changes in groundwater flow direction, flow velocity, and quantity have occurred to the upper hydrostratigraphic unit since 1996 and previous years. This review included evaluations of semiannual potentiometric surface maps, quarterly well pair linear flow velocity calculations, selected well hydrographs, and water level change maps. Comparison of the 1998 data to historical potentiometric surface maps (from previous annual reports) and historical water level trends presented in the individual well hydrographs provide a framework for identifying the type of potentiometric configurations, seasonal fluctuations, and long-term trends typically associated with pre-1996 plant operations. The 1996 data set, because it is the last year before the commencement of D&D activities (and to some extent the 1997 data set) comprises a sitewide baseline that will be used for assessing annual changes to the groundwater flow system during the remaining years of plant closure and post-closure monitoring.

3.1 Potentiometric Surface Maps

Groundwater potentiometric surface maps (Plates 2 and 3) were constructed from water level data collected during the second and fourth quarters (April and October data, respectively) of 1998 for the unconsolidated surficial deposits and selected weathered bedrock components comprising the UHSU. These maps provide information on groundwater flow direction and saturated extent that were used in the selection of well pairs for velocity calculations and definition of plume extent and movement. For map construction, it was assumed that well construction details, borehole logs, and water level measurements were accurate. When the measured depth to water was below the bottom of the well screen, the well was assumed to be dry.

Maps constructed for the UHSU were based entirely on data from fully penetrating wells screened in surficial deposits thought to be representative of regional shallow groundwater flow conditions. For this reason, wells completed in perched alluvial groundwater zones, such as wells 50494 and 51594 located west of the IA, were not utilized for construction of potentiometric contours. Information on unsaturated areas from previous UHSU potentiometric maps, particularly the 1993 maps, were used in the construction of the second and fourth quarter 1998 maps. Areas previously labeled as unsaturated were evaluated and reconfigured utilizing new monitoring well coverage (i.e., IA IM/IRA, D&D wells) and recent water level data. Shaded, non-contoured areas of the maps indicate areas where well coverage is absent. Conceptual potentiometric contour refinements were made in areas with new well coverage such as the north Industrial Area.

The configuration of the potentiometric surfaces for the second and fourth quarters of 1998 generally matches the configurations depicted for earlier quarterly maps.

Plant operations have potentially impacted groundwater flow patterns in areas where potentiometric contours appear to deviate from topographic or bedrock topographic configurations. For example, a prominent and persistent eastward distention of the 6,000 through 6,040-foot contour lines in the west IA deviates significantly from the pattern expected from the surface topography. The coincidence of this broad, mound-like feature within an industrialized portion of the Site suggests that a greater amount of recharge is occurring in this area compared to background areas with similar geologic conditions situated to the north and south. Likewise, the convergence and/or redirection of potentiometric contour lines in the immediate vicinity of Buildings 371, 771, 881, 865, and 997 suggest that foundation drains have localized impacts on groundwater flow in the IA. Unsaturated areas shown on the 1998 maps were generally less extensive than drawn on the 1996 maps (which were a reflection of the 1993 maps). This condition probably reflects the effects of higher than average precipitation at the site for the period of 1995 through 1997, in addition to improved sitewide well coverage.

3.2 Average Linear Flow Velocities

Average linear groundwater flow velocities (seepage velocities) were calculated for 24 UHSU well pairs within the Industrial Area and perimeter based on flow direction considerations derived from the 1998 potentiometric surface maps. The Darcy equation was used to calculate the seepage velocity (v):

$$v = \frac{K}{n}(dh / dl)$$

where:

K = hydraulic conductivity

n = effective porosity

dh/dl = hydraulic gradient

Values for hydraulic gradient were calculated from quarterly water level measurements made between well pairs located along a groundwater pathway. These well pairs were chosen on the basis of their perpendicular orientation to potentiometric contour lines. The data is not complete based on the fact that both well pairs are not necessarily visited for a water level measurement each quarter. Hydraulic conductivity values used for velocity calculations were derived from the geometric mean values reported for the Rocky Flats Alluvium, colluvium, and Arapahoe Formation sandstone (No. 1 Sandstone) presented in Table G-2 of EG&G (1995b). For each well pair, the K value chosen for the calculation was based on the predominant lithologic unit comprising the flow path between the wells. In the absence of measured values of n, a conservative value of 0.1 is assumed based on its predominant usage in previous velocity calculations performed at RFETS.

Groundwater flow velocities can be used as estimates of the migration rates for conservative (i.e., non-reactive) groundwater chemical constituents. Because they do not consider the effects of dispersion and chemical reactions (e.g., volatilization, biodegradation, dissolution/precipitation, and adsorption) on the concentrations of constituents along a flow path, seepage velocities approximate only the unattenuated rate of migration for dissolved constituents in groundwater. Attenuated, volatile, biodegradable, or redox-sensitive species will likely exhibit migration rates slower than the average linear velocity of groundwater flow.

Large-scale changes in the hydraulic gradient distribution caused by reconfiguration of the groundwater recharge and discharge regime during plant closure have the potential to impact groundwater flow directions and velocities which, in turn, can affect plume concentration, configuration, and movement. Although actual linear flow velocities at any given well pair are not known with certainty, changes in relative flow velocities, combined with potentiometric mapping and hydrograph analysis, can provide some insight into plume dynamics and movement. Linear flow velocity calculations are sensitive only to the magnitude and direction of the hydraulic gradient, assuming that the assigned values of K and n are kept constant. Temporal analysis of relative linear flow velocities using 1996 as a baseline year is expected to compliment the other available assessment tools (potentiometric and water level change maps, hydrographs, plume extent maps, etc.) in monitoring contaminant plume migration toward surface water.

As shown in Table 3-1, the calculated 1998 groundwater flow velocities ranged from approximately 16 feet per year (ft/yr) between well pair P419689/P416889, located in the IA, to approximately 475 ft/yr. between well pair 3687/60295, located in the East Trenches area. Linear flow velocities below 80 ft/yr tend to be associated with the Rocky Flats Alluvium while linear flow velocities above 80 ft/yr tend to be associated with colluvial (hillslope) material. The high value of 477 ft/yr, calculated for the fourth quarter of 1998 for well pair 3687/60296, is associated with the Arapahoe No. 1 Sandstone, which discharges to the hillside above South Walnut Creek.

"U" qualified. U-qualified data were given values of one-half the reported CRDL. VOCs have action levels low enough that the variation in CRDLs from one laboratory to another has caused some averages from wells with predominantly non-detect results to be above the Tier II action levels. The CRDLs exhibited the greatest variation for VOCs as a result of sample dilution reruns. For VOCs only, any CRDLs above 1 microgram per liter (µg/L) was adjusted to 1 µg/L, and the average was calculated using one-half the adjusted CRDL.

It should be noted that the term "plume map" is used here to delineate potential areas of elevated contaminant concentrations derived from each data set. In fact the map for a particular analyte may not show a plume at all, but rather just the distribution of the historical average chemical data results for that analyte. Because of assumptions made during data reduction, it is expected that these maps may contain a limited number of false values above Tier II action levels. Plume boundaries, where drawn, represent the best estimates of the spatial distribution of concentrations of selected chemicals of concern in groundwater at RFETS.

2.4.1 Volatile Organic Compound Plumes

Plate 10 presents a composite of four common VOC contaminants – TCE, PCE, vinyl chloride and carbon tetrachloride – which typify the type of VOC contamination found in general at RFETS. The map shows the estimated extent of Tier I (200 µg/L for vinyl chloride and 500 µg/L for TCE, PCE, and carbon tetrachloride) and Tier II (2 µg/L for vinyl chloride and 5 µg/L for TCE, PCE, and carbon tetrachloride) groundwater VOC contamination based on data collected during the period 1991 to 1998. Individual plume maps for these VOC contaminants were presented in the 1997 Annual RFCA Groundwater Monitoring Report (DOE, 1998), and should be consulted when examining VOC associations with specific source areas.

The VOC plume map has been updated from those published in previous Annual RFCA Groundwater Monitoring Reports (RMRS, 1997b and 1998) to reflect new data collected in 1998. The main area of change involved extending the Tier I and Tier II boundaries from the IA plume westward toward the unnamed drainage that separates the 700 area from Building 371/374. This change incorporates new VOC data collected from well points installed in 1998 for the northern IA plume evaluation (see Section 4.1). The Mound plume boundary was also broadened slightly to account for above Tier I action level TCE concentrations detected at well 00897. Refinements to the Tier II boundary were made at the leading edge of the 903 Pad/Ryan's Pit plume near the South Interceptor Ditch at Pond C-1, and along the east boundary of the IA plume near Building 779. The 903 Pad/Ryan's Pit plume boundary was redrawn to more accurately reflect the extent of VOCs found in the 1998 well points, which resulted in a retraction away from wells 2987 and 23196. The absence of VOCs above Tier II action levels in the Building 779 D&D wells (02297, 02397, and 02497) caused the IA Tier II boundary to be redrawn west of Building 779, thus resulting in a minor retraction of the boundary at Buildings 707 and 777. A small area of Tier II VOC contamination centered around D&D monitoring well 10498, located downgradient of Building 123, was also added to the map.

In 1999, an evaluation of the eastern boundary of the IA VOC plume was implemented to better define the extent of VOC contamination east of the Eighth Street utility corridor and upgradient of Buildings 707, 776, 778, 883, and 865. The proposed field investigation involves the installation and sampling of 15 small diameter wells along Eighth Street between Building 881 on the south and Building 771 on the north. Details of this investigation are specified in RMRS (1999c). The results of this investigation will be reported in the 1999 Annual RFCA Groundwater Monitoring Report .

2.4.2 Nitrate Plumes

The nitrate plume map has been updated slightly from those published in previous Annual RFCA Groundwater Monitoring Reports (RMRS, 1997b and 1998) to reflect new data collected in 1998. Plate 7 shows the estimated extent of Tier I (1,000 mg/L) and Tier II (10 mg/L) groundwater nitrate contamination based on data collected from the period 1991 to 1998. For reference, the background concentration for nitrate in groundwater at RFETS is 4.7 mg/L (DOE, 1993b).

Plate 7 illustrates one major nitrate plume (Solar Ponds Plume) and four minor areas. The Solar Ponds Plume (SPP) is located in the northeast portion of the PA and extends from the Solar Evaporation Ponds to the northeast towards North Walnut Creek. All values of nitrate over the Tier I action level are associated with this plume. The four minor areas of nitrate concentration above the Tier II action level are associated with the Old Landfill, the 903 and 904 Pads, IHSS 119.1 on the 881 Hillside, and an area west of the Present Sanitary Landfill Pond. Scattered occurrences of nitrate above the Tier II action level are also found at well 08391 (444 mg/L), located approximately 1200 feet east of the IA; wells 3386 (12.4 mg/L) and 22896 (12.1. mg/L) in the PA; well 00597 (10.1 mg/L) at the south perimeter of the Present Sanitary Landfill; and well 10498 (26 mg/L) downgradient of Building 123. The only significant change in nitrate plume extent involved extending the SPP Tier II boundary westward to encompass Buildings 774 and 779, and the eastern one third of Building 777. This change is based on consideration of historical nitrate data from building foundation drains available for PA Buildings 707, 771, 774, and 779 (DOE, 1994a) and new nitrate data from North IA well points installed in 1998 (see Section 4.1).

3.0 GROUNDWATER FLOW CONDITIONS DURING 1998

Groundwater level data collected throughout calendar year 1998 were reviewed to determine whether significant changes in groundwater flow direction, flow velocity, and quantity have occurred to the upper hydrostratigraphic unit since 1996 and previous years. This review included evaluations of semiannual potentiometric surface maps, quarterly well pair linear flow velocity calculations, selected well hydrographs, and water level change maps. Comparison of the 1998 data to historical potentiometric surface maps (from previous annual reports) and historical water level trends presented in the individual well hydrographs provide a framework for identifying the type of potentiometric configurations, seasonal fluctuations, and long-term trends typically associated with pre-1996 plant operations. The 1996 data set, because it is the last year before the commencement of D&D activities (and to some extent the 1997 data set) comprises a sitewide baseline that will be used for assessing annual changes to the groundwater flow system during the remaining years of plant closure and post-closure monitoring.

3.1 Potentiometric Surface Maps

Groundwater potentiometric surface maps (Plates 2 and 3) were constructed from water level data collected during the second and fourth quarters (April and October data, respectively) of 1998 for the unconsolidated surficial deposits and selected weathered bedrock components comprising the UHSU. These maps provide information on groundwater flow direction and saturated extent that were used in the selection of well pairs for velocity calculations and definition of plume extent and movement. For map construction, it was assumed that well construction details, borehole logs, and water level measurements were accurate. When the measured depth to water was below the bottom of the well screen, the well was assumed to be dry.

Maps constructed for the UHSU were based entirely on data from fully penetrating wells screened in surficial deposits thought to be representative of regional shallow groundwater flow conditions. For this reason, wells completed in perched alluvial groundwater zones, such as wells 50494 and 51594 located west of the IA, were not utilized for construction of potentiometric contours. Information on unsaturated areas from previous UHSU potentiometric maps, particularly the 1993 maps, were used in the construction of the second and fourth quarter 1998 maps. Areas previously labeled as unsaturated were evaluated and reconfigured utilizing new monitoring well coverage (i.e., IA IM/IRA, D&D wells) and recent water level data. Shaded, non-contoured areas of the maps indicate areas where well coverage is absent. Conceptual potentiometric contour refinements were made in areas with new well coverage such as the north Industrial Area.

The configuration of the potentiometric surfaces for the second and fourth quarters of 1998 generally matches the configurations depicted for earlier quarterly maps.

Plant operations have potentially impacted groundwater flow patterns in areas where potentiometric contours appear to deviate from topographic or bedrock topographic configurations. For example, a prominent and persistent eastward distention of the 6,000 through 6,040-foot contour lines in the west IA deviates significantly from the pattern expected from the surface topography. The coincidence of this broad, mound-like feature within an industrialized portion of the Site suggests that a greater amount of recharge is occurring in this area compared to background areas with similar geologic conditions situated to the north and south. Likewise, the convergence and/or redirection of potentiometric contour lines in the immediate vicinity of Buildings 371, 771, 881, 865, and 997 suggest that foundation drains have localized impacts on groundwater flow in the IA. Unsaturated areas shown on the 1998 maps were generally less extensive than drawn on the 1996 maps (which were a reflection of the 1993 maps). This condition probably reflects the effects of higher than average precipitation at the site for the period of 1995 through 1997, in addition to improved sitewide well coverage.

3.2 Average Linear Flow Velocities

Average linear groundwater flow velocities (seepage velocities) were calculated for 24 UHSU well pairs within the Industrial Area and perimeter based on flow direction considerations derived from the 1998 potentiometric surface maps. The Darcy equation was used to calculate the seepage velocity (v):

$$v = \frac{K}{n}(dh / dl)$$

where:

K = hydraulic conductivity

n = effective porosity

dh/dl = hydraulic gradient

Values for hydraulic gradient were calculated from quarterly water level measurements made between well pairs located along a groundwater pathway. These well pairs were chosen on the basis of their perpendicular orientation to potentiometric contour lines. The data is not complete based on the fact that both well pairs are not necessarily visited for a water level measurement each quarter. Hydraulic conductivity values used for velocity calculations were derived from the geometric mean values reported for the Rocky Flats Alluvium, colluvium, and Arapahoe Formation sandstone (No. 1 Sandstone) presented in Table G-2 of EG&G (1995b). For each well pair, the K value chosen for the calculation was based on the predominant lithologic unit comprising the flow path between the wells. In the absence of measured values of n, a conservative value of 0.1 is assumed based on its predominant usage in previous velocity calculations performed at RFETS.

Groundwater flow velocities can be used as estimates of the migration rates for conservative (i.e., non-reactive) groundwater chemical constituents. Because they do not consider the effects of dispersion and chemical reactions (e.g., volatilization, biodegradation, dissolution/precipitation, and adsorption) on the concentrations of constituents along a flow path, seepage velocities approximate only the unattenuated rate of migration for dissolved constituents in groundwater. Attenuated, volatile, biodegradable, or redox-sensitive species will likely exhibit migration rates slower than the average linear velocity of groundwater flow.

Large-scale changes in the hydraulic gradient distribution caused by reconfiguration of the groundwater recharge and discharge regime during plant closure have the potential to impact groundwater flow directions and velocities which, in turn, can affect plume concentration, configuration, and movement. Although actual linear flow velocities at any given well pair are not known with certainty, changes in relative flow velocities, combined with potentiometric mapping and hydrograph analysis, can provide some insight into plume dynamics and movement. Linear flow velocity calculations are sensitive only to the magnitude and direction of the hydraulic gradient, assuming that the assigned values of K and n are kept constant. Temporal analysis of relative linear flow velocities using 1996 as a baseline year is expected to compliment the other available assessment tools (potentiometric and water level change maps, hydrographs, plume extent maps, etc.) in monitoring contaminant plume migration toward surface water.

As shown in Table 3-1, the calculated 1998 groundwater flow velocities ranged from approximately 16 feet per year (ft/yr) between well pair P419689/P416889, located in the IA, to approximately 475 ft/yr. between well pair 3687/60295, located in the East Trenches area. Linear flow velocities below 80 ft/yr tend to be associated with the Rocky Flats Alluvium while linear flow velocities above 80 ft/yr tend to be associated with colluvial (hillslope) material. The high value of 477 ft/yr, calculated for the fourth quarter of 1998 for well pair 3687/60296, is associated with the Arapahoe No. 1 Sandstone, which discharges to the hillside above South Walnut Creek.

Table 3-1
Average Linear Flow Velocities for the Industrial Area and Vicinity

WELL PAIR	AREA	1998 QTR	dh/dl (gradient)	K (cm/sec)	n_e	v (cm/sec)	v (ft/yr)
P416289 / P416689	Industrial Area	1	0.0322	2.10E-04	0.1	6.76E-05	69.96
		2	0.0175	2.10E-04	0.1	3.68E-05	38.02
		3	N/D	2.10E-04	0.1	N/D	N/D
		4	0.0287	2.10E-04	0.1	6.03E-05	62.36
P419689 / P416889	Industrial Area	1	0.0077	2.10E-04	0.1	1.62E-05	16.73
		2	0.0124	2.10E-04	0.1	2.60E-05	26.94
		3	0.0072	2.10E-04	0.1	1.51E-05	15.64
		4	N/D	2.10E-04	0.1	N/D	N/D
P314289 / 10492	Industrial Area / S. Buffer	1	0.1261	9.33E-05	0.1	1.18E-04	121.73
		2	N/D	9.33E-05	0.1	N/D	N/D
		3	N/D	9.33E-05	0.1	N/D	N/D
		4	N/D	9.33E-05	0.1	N/D	N/D
5387 / 00797	881 Hillside	1	0.1920	9.33E-05	0.1	1.79E-04	185.34
		2	0.2121	9.33E-05	0.1	1.98E-04	204.75
		3	0.1610	9.33E-05	0.1	1.50E-04	155.42
		4	0.1709	9.33E-05	0.1	1.59E-04	164.97
34791 / 6386	SE Buffer	1	0.1915	9.33E-05	0.1	1.79E-04	184.86
		2	0.1950	9.33E-05	0.1	1.82E-04	188.24
		3	N/D	9.33E-05	0.1	N/D	N/D
		4	0.1868	9.33E-05	0.1	1.74E-04	180.32
07291 / 07391	903 Pad	1	0.0758	2.10E-04	0.1	1.59E-04	164.69
		2	0.0836	2.10E-04	0.1	1.76E-04	181.64
		3	0.0780	2.10E-04	0.1	1.64E-04	169.48
		4	N/D	2.10E-04	0.1	N/D	N/D
00491 / 23196	SE Buffer	1	0.1623	9.33E-05	0.1	1.51E-04	156.67
		2	0.1686	9.33E-05	0.1	1.57E-04	162.75
		3	0.1662	9.33E-05	0.1	1.55E-04	160.44
		4	N/D	9.33E-05	0.1	N/D	N/D
04591 / 10194	903 Pad	1	0.0124	2.10E-04	0.1	2.60E-05	26.94
		2	0.0117	2.10E-04	0.1	2.46E-05	25.42
		3	0.0088	2.10E-04	0.1	1.85E-05	19.12
		4	N/D	2.10E-04	0.1	N/D	N/D
05291 / 05091	East Trenches	1	0.0221	2.10E-04	0.1	4.64E-05	48.02
		2	0.0219	2.10E-04	0.1	4.60E-05	47.58
		3	N/D	2.10E-04	0.1	N/D	N/D
		4	N/D	2.10E-04	0.1	N/D	N/D
05391/06091	East Trenches	1	0.0175	2.10E-04	0.1	3.68E-05	38.02
		2	0.0180	2.10E-04	0.1	3.78E-05	39.11
		3	0.0161	2.10E-04	0.1	3.38E-05	34.98
		4	0.0142	2.10E-04	0.1	2.98E-05	30.85
4286/20291	East Trenches	1	0.0146	2.10E-04	0.1	3.07E-05	31.72
		2	0.0246	2.10E-04	0.1	5.17E-05	53.45
		3	0.0219	2.10E-04	0.1	4.60E-05	47.58
		4	0.0206	2.10E-04	0.1	4.33E-05	44.76
3687/60295	East Trenches	1	0.0573	7.88E-04	0.1	4.52E-04	467.17
		2	0.0527	7.88E-04	0.1	4.15E-04	429.66
		3	N/D	7.88E-04	0.1	N/D	N/D
		4	0.0585	7.88E-04	0.1	4.61E-04	476.95
00191/13491	903 Pad	1	0.0172	2.10E-04	0.1	3.61E-05	37.37
		2	0.0312	2.10E-04	0.1	6.55E-05	67.79
		3	N/D	2.10E-04	0.1	N/D	N/D

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Table 3-1
Average Linear Flow Velocities for the Industrial Area and Vicinity

WELL PAIR	AREA	1998 QTR	dh/dl (gradient)	K (cm/sec)	n_e	v (cm/sec)	v (ft/yr)
		4	N/D	2.10E-04	0.1	N/D	N/D
1987/3586	Mound	1	0.1003	9.33E-05	0.1	9.36E-05	96.82
		2	0.1030	9.33E-05	0.1	9.61E-05	99.43
		3	0.0981	9.33E-05	0.1	9.15E-05	94.70
		4	N/D	9.33E-05	0.1	N/D	N/D
05293 / 3386	Solar Pond	1	0.0546	2.10E-04	0.1	1.15E-04	118.63
		2	0.0527	2.10E-04	0.1	1.11E-04	114.50
		3	0.0521	2.10E-04	0.1	1.09E-04	113.20
		4	N/D	2.10E-04	0.1	N/D	N/D
P218389 / B208089	Solar Pond	1	0.0509	9.33E-05	0.1	4.75E-05	49.14
		2	0.0532	9.33E-05	0.1	4.96E-05	51.36
		3	0.0528	9.33E-05	0.1	4.93E-05	50.97
		4	0.0507	9.33E-05	0.1	4.73E-05	48.94
2286 / 45793	Solar Pond	1	Dry	2.10E-04	0.1	N/D	N/D
		2	0.0622	2.10E-04	0.1	1.31E-04	135.15
		3	N/D	2.10E-04	0.1	N/D	N/D
		4	Dry	2.10E-04	0.1	N/D	N/D
1986 / 77492	Solar Pond	1	0.0261	9.33E-05	0.1	2.44E-05	25.19
		2	0.0250	9.33E-05	0.1	2.33E-05	24.13
		3	0.0203	9.33E-05	0.1	1.89E-05	19.60
		4	N/D	9.33E-05	0.1	N/D	N/D
P114689 / 22896	Industrial Area / PA	1	0.0267	2.10E-04	0.1	5.61E-05	58.01
		2	0.0225	2.10E-04	0.1	4.73E-05	48.89
		3	N/D	2.10E-04	0.1	N/D	N/D
		4	0.0221	2.10E-04	0.1	4.64E-05	48.02
P215789 / P218089	Industrial Area / PA	1	0.0166	2.10E-04	0.1	3.49E-05	36.07
		2	0.0080	2.10E-04	0.1	1.68E-05	17.38
		3	N/D	2.10E-04	0.1	N/D	N/D
		4	0.0073	2.10E-04	0.1	1.53E-05	15.86
P313489 / 6186	Industrial Area	1	0.0119	2.10E-04	0.1	2.50E-05	25.86
		2	0.0152	2.10E-04	0.1	3.19E-05	33.03
		3	N/D	2.10E-04	0.1	N/D	N/D
		4	0.0098	2.10E-04	0.1	2.06E-05	21.29
4486 / P115689	Industrial Area	1	0.0196	2.10E-04	0.1	4.12E-05	42.59
		2	0.0162	2.10E-04	0.1	3.40E-05	35.20
		3	N/D	2.10E-04	0.1	N/D	N/D
		4	0.0227	2.10E-04	0.1	4.77E-05	49.32
P415989 / P115489	Industrial Area	1	0.0209	2.10E-04	0.1	4.39E-05	45.41
		2	0.0212	2.10E-04	0.1	4.45E-05	46.06
		3	N/D	2.10E-04	0.1	N/D	N/D
		4	N/D	2.10E-04	0.1	N/D	N/D
P115089 / P119389	Industrial Area / PA	1	0.0229	2.10E-04	0.1	4.81E-05	49.76
		2	0.0292	2.10E-04	0.1	6.13E-05	63.44
		3	0.0225	2.10E-04	0.1	4.73E-05	48.89
		4	N/D	2.10E-04	0.1	N/D	N/D

Notes: DRY indicates at least one well was dry for the quarter.
N/D indicates no data for at least one well for the quarter.

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Linear flow velocity data from 1998 are more comprehensive than for 1996. Generally, water level data were collected for more quarters per well pair in 1998 compared to 1996. Water level data for many well pairs were reported for only one quarter in 1996. For well pairs that had more than one quarter of data for both years, the velocities generally are less consistent (more variant) from quarter to quarter during 1998 than for 1996. This is a response to moderate change in hydraulic gradient from quarter to quarter, and may be a result of the amount and distribution of precipitation with respect to time.

In general, velocities for the 24 well pairs vary by less than 25 percent when comparing the same quarters from 1996 to 1998. The following exceptions occurred. At well pair 04591/10194, in the vicinity of the 903 Pad, first quarter data reveals an increase in linear flow velocity of approximately 60 percent from 1996 to 1998, and third quarter data reveals a decrease in flow velocity of approximately 50 percent from 1996 to 1998. The other exceptions were for well pairs where only one quarter of water level data was available for 1996, or only one quarter out of four showed a variance of greater than 25 percent. One such exception is well pair P314289/10492, located in the IA/south Buffer Zone, where the first quarter in 1998 showed an approximately 50 percent increase in linear flow velocity from the same quarter in 1996. Another is at well pair P419689/P416889, located in the IA, where the second quarter in 1998 showed an approximately 60 percent increase in flow velocity from the same quarter in 1996. This indicates that the hydraulic gradient was steeper between these well pairs, for these quarters, in 1998. At well pair P416289/P416689, located in the IA, second quarter 1998 data revealed an approximately 50 percent decrease in flow velocity from 1996 to 1998. At well pair P313489/6186, located in the IA, fourth quarter data revealed an approximately 50 percent decrease in flow velocity from 1996 to 1998. This indicates that the hydraulic gradient was steeper between these well pairs, for these quarters, in 1996. It is interesting to note that the major changes in flow velocities between 1996 and 1998 took place in well pairs located in the IA. This might be expected in the IA versus the Buffer Zone because of all the artificial features associated with the IA (building drains, pavement, piping and utility corridors, etc.). Velocities reported for 1996 through 1998 are generally higher than velocities reported in pre-1996 annual RCRA groundwater monitoring reports largely because sitewide mean K values are now employed in the calculations instead of individual operable unit mean K values.

3.3 Well Hydrographs and Water Level Change Maps

Hydrograph plots for many RFCA water quality wells have been constructed in order to observe changes in water table elevation with time (see Appendix B). In addition to illustrating seasonal fluctuations in water table elevation, hydrographs are useful for evaluating long-term trends that might result from either artificial activities (plant closure) or natural causes (climatic change). For example, a comparison of IA well hydrograph data to background well hydrograph data may suggest whether any of the observed trends are natural or artificially induced. Assuming that groundwater levels within the Site have reached a quasi-steady state condition since the cessation of production operations in 1989, it is conceivable that plant closure activities could cause local water levels to rise or fall, depending on the closure action. These changes in water level elevations will be evaluated in future years using annual and life-of-closure water level change maps that will be based on water levels collected during the 1996 baseline year.

Water levels measured during 1998 were, for the most part, observed to fluctuate within normal limits. Some wells, including recharge-sensitive wells such as 20691, 4286, 12191, B200889, and P416689 exhibited very high recharge peaks during the spring season. In general, for all site wells, water levels were higher during the first half of 1998 compared to the second half. Only B-series wells generally displayed higher water levels during the second half of 1998. Overall, water levels were higher in 1998 than in 1996. Water levels in 1996, which were higher than average, were thought to reflect the residual influence of the record high water levels experienced in 1995. Sitewide precipitation data from 1993 through 1998 indicates that precipitation was very high in 1995, 1996 produced near average precipitation, 1997 produced well above average precipitation, and 1998 produced near average precipitation. The continuing higher than average water levels may be based as much on recurrent high precipitation (ample recharge) since 1995 as they are on the residual effects of 1995 and 1997. The sitewide scale of this trend, also observed in background wells, implies that climate is the dominant cause of water level changes during 1998.

Water level change maps (Plates 8 and 9) utilizing 1998 and 1996 water level data, are presented here for the second time in an annual report. These data are used to compare the 1998 water levels for the second (April data) and fourth (October data) quarters to the second and fourth quarter water level data for 1996. Data plotted on these water level change maps indicate areas of the site where changes in saturated thickness, either positive or negative, have taken place between the two given years. It is important to keep in mind that wells that have been purged for sample collection, and have a slow recharge rate, can be responsible for a large discrepancy in water level change from 1996 to the year of the current RFCA Annual Report.

The water level change map for the spring quarters of 1996 and 1998 (Plate 8) generally shows that almost all changes are positive compared to 1996; there was generally a higher spring water table in 1998 than in 1996. The central and southern PA has virtually no change from 1996 to 1998. Along the eastern PA boundary there is a steep positive gradient of up to 6 feet, then a grading back eastward to almost no change by Pond B-2. The northern edge of the PA shows a zero to one-foot positive change from 1996 to

1998. The west central and western IA generally shows positive water level change (1-3 feet) out to the west spray fields where there is virtually no change. Water level changes become positive again to the west, up to 3-4 feet, just east of Highway 93 and west of the gravel pits. The northwest portion of the IA exhibits positive water level changes of up to 5 feet, and a localized area just west of building 371 (well P114589) exhibits positive changes of up to 30-plus feet. Another area of high positive water level changes is immediately south and southwest of Building 440, with changes up to 13 feet from 1996 to 1998. Upgradient of the Present Landfill is an area of 6-8 feet of positive change in the water table elevation from 1996 to 1998. Approximately 2500 feet south of the Trailer 130 complex is an area of 2 to 5-plus feet of positive water level change. Additional bullseyes identified on Plate 8 indicate areas of significant change, from 1996 to 1998, in water levels for the spring quarter.

The water level change map for the fall quarters of 1996 and 1998 (Plate 9) shows that, in general, there is a greater mix of positive and negative water table elevation change throughout the site than presented on the spring quarters of 1996 to 1998 water level change map. West of the IA there are only positive changes, and east of the IA there are almost all positive changes except for a few isolated areas of negative change. The west central IA shows an area of 1-3 feet of negative water level change from 1996 to 1998. This area of negative change is surrounded by zero change areas from the western PA trending southwest through the southwest portion of the IA, and from the western SEP trending south/southwest through the central IA. The eastern third of the IA exhibits an area, from west to east, of 2 feet of positive to 2 feet of negative water level change from 1996 to 1998. An area to note is in the vicinity of Cactus and First Street where there is a steep gradient, from west to east, from a positive 2 feet to a negative 3 feet of water level change within a linear distance of approximately 250 feet. In addition, immediately west of Building 371 is an isolated area (well P114589) of approximately 30 feet of positive water level change from 1996 to 1998. Approximately 2500 feet south of the Trailer 130 complex is an area of 2 to almost 6 feet of positive water level change. Additional bullseyes on Plate 9 indicate areas of significant change, from 1996 to 1998, in water levels for the fall quarter.

In summary, groundwater flow conditions for 1998 appear to generally resemble flow conditions described for recent years with slight variations depending on the location within RFETS. This situation is not unexpected because only minor plant closure activities have been undertaken to date. The variations in water levels and linear flow velocities are probably in response to the timing of water level measurements with respect to natural recharge (precipitation), artificial recharge, or artificial dewatering events. Artificial events may involve recharge or dewatering related to construction, demolition, onsite industrial processes, monitoring well sampling, and building perimeter drain activity or inactivity. The

1996 data set (and to some extent the 1997 data set) will represent the baseline for future annual evaluations.

4.0 GROUNDWATER EVALUATIONS

4.1 Industrial Area Plume

4.1.1 Introduction

The major groundwater evaluation activity in 1998 consisted of an evaluation of four wells in the groundwater program that had VOC concentrations that were above action levels. Wells 22696, 22796 and 22896 were installed in 1996. They were part of the original Industrial Area IM/IRA monitoring program to serve as monitoring points for possible groundwater contamination emanating from the 700 building complex during D&D activities. At the time of installation, it was not anticipated that these wells would discover pre-existing groundwater contamination. Well P219189 was installed in 1989 and is located north of Building 774 near Bowman's Pond. Figure 4-1 shows the location of these wells.

Data from well 22696 has shown Trichloroethene (TCE) concentrations above Tier II action levels. Table 4-1 shows the latest 1998 data for this well. The TCE concentration, although low, is in an area that has not been investigated for possible groundwater contamination. Well 22796 shows concentrations of TCE above Tier II action levels. This well is also in an area that has not been investigated for groundwater contamination. Well 22896 was installed near Building 559. This well shows TCE concentrations above Tier I action levels. Well P209189 has historically shown 1,1 dichloroethene (1,1, DCE) above Tier II action levels. Carbon tetrachloride (carbon tet) is also seen in this well. This well is one of the few wells on Site that contains anomalous concentrations of 1,1-DCE.

The location of these wells near flowing streams suggested that a potential impact to surface water may be possible. Wells 22796 and P219189 are near the Walnut Creek drainage, though the stream has been re-routed through culverts in the general area. Wells 22696 and 22896 are upgradient of a small tributary stream that flows north to Walnut Creek on the east side of Building 371. This stream is fed by a number of pipes and culverts along its path and therefore does not depend upon groundwater influx as it's only source of recharge. Well 1986 is a routine monitoring well located near this stream which showed TCE above action levels (28 µg/L) for the first time in ten years (see Figure 4-1). Because of this, the previous sample result was used pending confirmation of the October sample.

To investigate potential impacts to surface water, a line of temporary wells were installed between the anomalous wells and the streams. Twenty-three wells were installed that were spaced approximately one hundred feet apart. The RFETS Geoprobe unit was used to install the one inch diameter wells, which were completed below ground surface and protected by a flush mounted metal cap. The wells were installed in or on the side of two existing paved roads, to allow for sampling access. Ten wells were installed in an east-west direction to cover the potential groundwater pathways from wells P219189 and 22796. The rest of the wells were installed on a southwest-northwest line that would define groundwater pathways downgradient of wells 22696 and 22896. The wells were sampled for VOCs as these are the only compounds that exceed action levels. The wells were installed in the third quarter, and sampled during the fourth quarter of 1998. Table 4-1 shows the results of the fourth quarter sampling for the temporary wells, which are numbered 20098-22298. Also in support of the evaluation effort, in the first quarter of 1999, well 77492 was sampled and a stream sample was taken near well 1986.

4.1.2 Hydrogeology

The line of temporary wells is located in an area that was originally composed of hillslope colluvium where it interfingers with valley fill alluvium materials near Walnut Creek and the small tributary stream. Cut and fill activities during construction of the 700 building complex have resulted in areas of fill which are composed dominantly of colluvial material. As such, the dominant lithology in the wells is sandy clay and clayey sand which is interbedded with one half to three foot intervals of clayey to sandy gravel. These gravel intervals are thought to be the edge of the valley fill alluvium which probably does not extend much farther upslope of the Geoprobe line. For this reason these coarser intervals were not factored into the flux calculations discussed in a later section. The Geoprobe holes were taken down to the bedrock contact and the wells were screened so as to include the contact in the screened interval. Wells 21998, 22098 and 22198 did not intersect bedrock due to refusal problems. Bedrock lithology in this area is typically a moderately weathered claystone. Figure 4-1 contains the potentiometric surface for the north IA based on water levels taken in the fourth quarter of 1998. In general the potentiometric surface mimics the topography, and suggests that groundwater flow from the 700 building complex can head northwest, north and northeast.

4.1.3 Evaluation of Sampling Results

The results of the VOC sampling from the temporary wells have been summarized in Table 4-1. Only those VOC compounds for which significant concentrations were detected are listed. In addition, data from other wells in the area is included in Table 4-1 for the purposes of assessing the possible nature and extent of the groundwater contamination. The concentrations of TCE, carbon tet, chloroform, 1,1-DCE and vinyl chloride are presented in Figures 4-2 through 4-6, respectively. It can be seen that the groundwater contamination seen in the area can be related based on the dominant VOCs detected.

Table 4-1
Volatile Organic Compounds in Groundwater North IA Plume

Well	Sample Type	Fall Wate	Sample Date	Concentration in ug/L cis/trans 1,2 Dichloro-ethene	1,1 Dichloro-ethane	Vinyl Chloride	Carbon Tetra-chloride	Trichloro-ethene	1,1 Dichloro-ethene	Tetra-chloro-ethene	Chloroform	Total VOCs
22098	Geoprobe well	5989.5	9/17/98	U	U	U	U	U	U	U	U	0
21998	Geoprobe well	5985.7	9/15/98	U	U	U	U	U	U	U	U	0
21898	Geoprobe well	5970.0	9/23/98	4	1	U	U	10	1	7	U	23
21798	Geoprobe well	5966.4	9/15/98	10	7	12	U	8	2	U	U	39
21698	Geoprobe well	5957.4	3/29/99	8	U	U	U	29	U	7	U	44
21598	Geoprobe well	5963.7	9/23/98	6	U	U	4	86	3	U	U	99
21498	Geoprobe well	5955.3	9/22/98	U	U	U	4	2	U	U	2	8
21398	Geoprobe well		Dry									0
21298	Geoprobe well	5946.9	9/22/98	U	U	U	8	U	U	U	4	12
21198	Geoprobe well	5945.7	9/22/98	U	U	U	7	U	U	U	5	12
21098	Geoprobe well	5946.0	9/24/98	U	U	U	1800	U	U	U	410	2210
20998	Geoprobe well	5944.9	9/23/98	U	U	U	42	U	U	U	130	172
20898	Geoprobe well	5938.8	9/21/98	U	U	U	96	U	U	4	95	195
20798	Geoprobe well	5927.7	9/21/98	1.6	3	U	U	U	U	U	U	4.6
20698	Geoprobe well	5923.2	9/28/98	10	2	3	U	16	U	U	U	31
20598	Geoprobe well	5940.3	9/28/98	4	4	8	U	U	20	U	U	36
20498	Geoprobe well	5927.8	9/23/98	3	9	7	U	U	110	U	U	129
20398	Geoprobe well	5926.9	9/23/98	1	5	1	U	U	4	U	U	11
20298	Geoprobe well	5925.9	9/24/98	U	2	U	U	U	U	U	U	2
20198	Geoprobe well	5932.0	9/23/98	U	U	U	U	U	U	U	U	0
20098	Geoprobe well	5922.0	9/16/98	15	U	U	U	U	U	U	U	15
22198	Geoprobe well	5920.6	9/22/98	U	U	U	U	U	U	U	U	0
22298	Geoprobe well	5916.7	9/24/98	U	U	U	U	U	U	U	U	0
1986	Well	5940.3	6/17/98	U	U	U	U	U	U	U	U	0
2286	Well		7/12/95	U	U	U	180	180	U	U	38	
5687	Well		7/12/95	13	10	2	U	68	5	4	6	
P210189	Well		4/14/98a	68	U	U	5200	3100	U	U	340	8708
P209189	Well		4/14/98a	2	U	U	1	5	U	U	U	8
P209289	Well	5968.67	4/14/98a	U	U	U	49	U	U	U	46	95
P219189	Well	5931.15	6/16/98	U	29	U	7	U	30	U	2	68
P209489	Well	5950.84	5/13/98	11	0.4	U	52	63	1	3	20	150.4
P209389	Well	5964.43	2/23/99	U	1	U	1.6	U	36.1	2	2.8	
77492	Well		3/26/99	U	U	U	U	U	U		U	
42393	Well		4/14/98a	U	U	U	U	U	U	U	U	0
41993	Well		12/15/97	U	U	U	U	0.5	U	0.5	U	1
45693	Well		12/8/97	U	U	U	U	2	U	0.5	1	3.5
45893	Well		12/15/97	8	1	U	74	64	1	6	16	170
30595	Well		12/17/97	U	U	U	1	6	U	1	2	10
22696	Well	5964.03	8/31/98	U	U	U	U	10	2	U	U	12
22796	Well	5929.62	6/16/98	11	U	U	U	29	U	U	U	40
22896	Well	5980.5	9/1/98	3	U	U	U	2400	U	U	U	2403
02497	Well	5970.11	11/3/98	U	U	U	U	3	U	U	1	
18199	Well		3/26/99	U	U	U	15400	3	37.6	1.6	2200	17642.2
18299	Well		3/26/99	U	U	U	3280	1.1	U	U	1600	4881.1
18399	Well		3/26/99	U	U	U	23000	U	U	U	3430	26430
18499	Well		3/26/99	U	1.4	U	57800	3.4	150	2.3	8750	66707.1
18599	Well		3/26/99	U	2.4	U	31900	1	27.9	3.5	4300000	4331934.8
18699	Well		3/26/99	U	1.5	U	5	U	U	1.2	U	7.7
18799	Well		3/26/99	U	U	U	927	U	5.8	6.8	511	1450.6
771FDOUT #2	Pipe		3/26/99	U	U	U	12	U	1	U	23	36
771Manhole #3	Pipe		3/26/99	U	U	U	U	U	U	U	U	0
MW771 Manhole	Pipe		3/26/99	U	U	U	U	U	U	U	U	0
1986 Stream	Stream		3/26/99	U	U	U	U	U	U	U	U	
Action Level	ug/L			70	1000	2	5	5	7	5	100	1194

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The following is a breakdown of the data with respect to nature and extent of contamination: Wells 21599, 21699,21799 and 21899 are dominated by TCE with attendant PCE and vinyl chloride concentrations above Tier II action levels. The VOC signature in these wells is similar to VOCs found in wells 22698 and 22898. Recent plume concentration maps generated as part of the 1997 Annual Groundwater Monitoring Report (DOE, 1998) have associated well 22896 with the northern extent of the IA VOC plume, and the high concentration of TCE suggests a nearby source. With the addition of the temporary well data, it now appears that the northern IA plume extends farther north than originally thought and is in a position to have contact with the stream in this area. Figure 4-2 shows the spatial relation of TCE detections to the north IA .

Wells 20898, 20998, 21098, 21198, and 21298 are dominated by carbon tet with attendant chloroform above Tier II action levels. There is no TCE or PCE in these wells, which suggests a different source for the groundwater contamination in this area. Figures 4-3 and 4-4 show the concentration of carbon tet and chloroform in the north IA. Table 4-1 includes the recent data collected from the natural attenuation project for IHSS 118.1 (RMRS, 1999d). IHSS 118.1 is a former carbon tet tank location which experienced numerous historic spills and/or leaks. The tank has since been removed. A drilling and sampling program was designed at IHSS 118.1 to collect the data necessary for decision making with respect to natural attenuation. Eight wells were installed in a pattern so as to have two wells upgradient of the DNAPL source, and three wells along an east-west line where two wells were in the source, and one well was located cross gradient to the source (see Figure 4-9). The remaining three wells were installed in a line approximately 60 to 70 feet downgradient from the source. The wells were installed in February 1999 and the first round of sampling was completed by the end of March. In addition, VOC samples were taken of two manholes and one pipe outfall, that are thought to be associated with the Building 771 footing drain system, which lies on the south side of Building 771. Building 771 is approximately 120 feet due north of the IHSS 118.1 source and the footing drain is thought to be intercepting a portion of the VOC plume. Figure 4-1 shows the location of the wells and other sampling locations.

The VOC signature from the IHSS 118.1 wells matches the VOC signature from the temporary wells listed above. Because chloroform is a breakdown product of carbon tet, it is predictable that these two compounds would occur together. Carbon tet was also found above Tier II action levels in sample 771FDOUT #2 which is from an outfall pipeline thought to be related to the 771 footing drain system (see Figure 4-3). Based on the information at hand, it appears that carbon tet plume from IHSS 118.1 is migrating westward towards the stream in concentrations that could impact surface water. In addition, there is evidence that the plume is being captured in part by the 771 footing drain system. Wells 1986 and 77492 lie due west and northwest of the carbon tet plume as seen in the temporary wells. Groundwater sample data from these wells, and a stream sample taken near well 1986 showed no detections for VOCs. If a pathway to surface water exists here, it must be between these two locations.

Given the evidence for a groundwater pathway to the west of IHSS 118.1, existing data was evaluated to determine if additional pathways may exist to the north and east of the latter. Wells 20198, 20098, 22198, and 22298 were installed to determine if a pathway form the carbon tet plume to surface water existed in this area. Data from these temporary wells shows no detections for VOCs. Table 4-1 and Figures 4-2 through 4-6 also show data from existing wells located to the east of IHSS 118.1. Well P209289 is east of IHSS 118.1 and shows the same VOC signature as other wells associated with the carbon tet plume. Wells P210189, P209489, 2286 and 45893 show carbon tet and chloroform above Tier II action levels, but also contain TCE above Tier II action levels. In fact both TCE and carbon tet have historically been above Tier I action levels in well P210189. Well 5687, which is located to the south of well P210189 has high TCE and very low concentrations of carbon tet. The data suggest that wells in this cluster are possibly being affected by multiple sources; a TCE source and a carbon tet source. It is possible that IHSS 118.1 is contributing the carbon tet that is found in this area.

Well 45893 is north of the possible TCE source and northwest of IHSS 118.1. This is the farthest well to the north that shows both TCE and carbon tet. Well 30595 is farther north outside the PA, near the Walnut Creek drainage and does show TCE above Tier II action levels. It is possible that a pathway exists in the area of these two wells. Given that the Solar Evaporation Ponds (SEPs) groundwater collection and treatment system is being installed in this area, this pathway may no longer require additional investigation. Well P219189 is north of IHSS 118.1 and does show carbon tet above Tier II action levels. However, temporary wells to the north of this well do not show any carbon tet.

The third area of groundwater contamination is located due north of Building 771and involves temporary wells 20498, 20598 and 20698. These three wells show detections of vinyl chloride above Tier II action levels. Well 20498 also shows TCE above Tier II action levels and well 20698 shows 1,1-DCE above Tier II action levels. The VOC signature for well 20698 closely matches existing well 22796 in that both wells show TCE concentrations. Well 20498 is similar to well P219189 in that they both contain 1,1-DCE above action levels. However, the two wells differ in that well 20498 contains TCE as opposed to P219189, which contains carbon tet above Tier II action levels.

4.1.4 Plume Flux Calculations

Plume flux estimates were made to establish the potential impact to surface water from the three contaminant plume areas referenced above and identified from the Geoprobe drilling project. Table 4-1 was used to derive the total concentration of VOCs detected in each well. Table 4-2 presents the results of calculations to determine the flux of contaminated groundwater to the stream.

Saturated thickness was determined by estimating the feet of water column between the water table elevation and the bottom of the screen. Since all wells are screened primarily in alluvial materials, the bedrock portion of the borehole is typically only a foot or less in thickness.

Transmissivity was calculated by using the saturated thicknesses derived from both fall and spring water levels and using estimates of hydraulic conductivity for colluvial materials from the 1995 Hydrogeologic Characterization Report (EG&G, 1995b). Transmissivities were calculated using the minimum, maximum and geometric mean hydraulic conductivities found in Table G-2 of the Hydrogeologic Report (EG&G, 1995b). Colluvial materials at RFETS are variable in composition both in the vertical dimension in the borehole, but also in the horizontal dimension. Therefore, no attempt was made to make adjustments to hydraulic conductivity based on lithologic changes seen in the colluvium.

The estimated discharge was calculated on a per well basis using the mean transmissivity values for fall and spring periods. The hydraulic gradient was estimated using the difference between water levels in wells 22896 and the elevation of the stream near Geoprobe well 21598. This gradient was used for all wells due to the paucity of upgradient wells available in the area and the complications caused by buildings and associated alterations to the topography. The length perpendicular to flow was set at 100 feet, which is the distance between the temporary wells. Total discharge for the three contaminant plumes is seen at the bottom of Table 4-2.

Using the calculated discharge, and the total VOC concentration data in Table 4-1, an estimate of contaminant load was calculated in Table 4-2. Loads were calculated using both spring and fall data and the total load for each plume occurs at the bottom of the table. Using the load and discharge estimates, a total flux of VOC contaminants is calculated. The wells involved in each plume are labelled and outlined with a dark line in Table 4-2. The flux for the TCE plume is 0.001 Kg/day, 0.015 Kg/day for the carbon tet plume, and 0.001 Kg/day for the vinyl chloride plume.

4.1.5 Conclusions and Recommendations

The results of this investigation suggest that groundwater contamination above groundwater action levels exists in the general area of the unnamed tributary drainage to Walnut Creek in the IA. Well 1986, located in the drainage itself, does not show VOC concentrations above action levels, nor did a surface water sample collected in the stream adjacent to well 1986. Well 77492 also shows no VOC detections,

Table 4-2
Plume Flux Calculations
No. IA Plume

									Fall Water Level Data			Spring Water Level Data								
		Sep-98	Mar-98		Bottom		Fall	Spring	Transmissivity	Transmissivity	Transmissivity	Transmissivit	Transmissivity	Transmissivity					Fall	Spring
	Casing	Water	Water	Creek	of Screen		Saturated	Saturated	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Discharge 'Q'	Discharge 'Q'	Fall Load	Spring Load	GW Flux	GW Flux
Well	Elevation	Level	Level	Elevation	Elevation		Thickness	Thickness	ft2/day	ft2/day	ft2/day	ft2/day	ft2/day	ft2/day	Fall gal/min	Spring gal/min	gram/day/f	gram/day/ft	kg/day)	(kg/day)
22098	5999.60	10.10	10.19	6000	5975	N	14.50	14.41	0.16443	38.229975	3.8229975	0.1634094	37.9926855	3.79926855	0.101880401	0.10124804	0	0		
21998	5994.60	8.94	8.80	6000	5975	N	10.66	10.80	0.1208844	28.105623	2.8105623	0.122472	28.47474	2.847474	0.07489966	0.075883333	0	0	TCE Plume	
21898	5988.60	18.61	18.14	5980	5967		2.99	3.46	0.0339066	7.8832845	0.78832845	0.0392364	9.122463	0.9122463	0.021008441	0.024310772	0.000513	0.0005942	5.1E-05	5.94E-05
21798	5981.50	15.06	14.66	5975	5958		8.44	8.84	0.0957096	22.252482	2.2252482	0.1002456	23.307102	2.3307102	0.05930142	0.062111913	0.002458	0.00257422	0.00025	0.000257
21698	5973.90	16.53	15.65	5970	5957.5		0.00	0.00	0	0	0	0	0	0	0	0	0	0	0	0
21598	5969.70	5.96	4.79	5960	5955		8.74	9.91	0.0991116	23.043447	2.3043447	0.1123794	26.1282105	2.61282105	0.06140929	0.069629984	0.006461	0.00732551	0.00065	0.000733
21498	5964.60	9.34	3.10	5960	5954		1.26	7.50	0.0142884	3.322053	0.3322053	0.08505	19.774125	1.9774125	0.008853056	0.052696759	7.53E-05	0.000448		
21398	5966.70	DRY	14.23	5955	5952		0.00	0.00	0	0	0	0	0	0	0	0	0	0	Carbon Tet Plume	
21298	5958.70	11.82	10.14	5950	5939		7.88	9.56	0.0893592	20.776014	2.0776014	0.1084104	25.205418	2.5205418	0.055366728	0.067170802	0.000706	0.00085658	7.1E-05	8.57E-05
21198	5957.50	11.85	10.38	5945	5928		17.65	19.12	0.200151	46.5351075	4.65351075	0.2168208	50.410836	5.0410836	0.12401304	0.134341605	0.001581	0.00171316	0.00016	0.000171
21098	5959.00	13.00	11.37	5940	5939		7.00	8.63	0.07938	18.45585	1.845585	0.0978642	22.7534265	2.27534265	0.049183642	0.060636404	0.11551	0.14240733	0.01155	0.014241
20998	5954.90	10.03	10.19	5940	5943		1.87	1.71	0.0212058	4.9303485	0.49303485	0.0193914	4.5085005	0.45085005	0.013139059	0.012014861	0.002402	0.00219611	0.00024	0.00022
20898	5945.50	6.71	6.75	5940	5930		8.79	8.75	0.0996786	23.1752745	2.31752745	0.099225	23.0698125	2.30698125	0.061760602	0.061479552	0.012798	0.01274007	0.00128	0.001274
20798	5943.40	15.75	16.63	5935	5917		10.65	9.77	0.120771	28.0792575	2.80792575	0.1107918	25.7590935	2.57590935	0.074829398	0.068646312	0.000366	0.00033557	Vinyl Chloride Plum	
20698	5942.70	19.55	19.51	5935	5921		2.15	2.19	0.024381	5.6685825	0.56685825	0.0248346	5.7740445	0.57740445	0.015106404	0.015387454	0.000498	0.00050691	5E-05	5.07E-05
20598	5940.30		12.81	5930	5926		0.00	1.49	0	0	0	0.0168966	3.9284595	0.39284595	0	0.010469089	0	0.00040051	0	4.01E-05
20498	5939.47	11.70	11.85	5925	5918		9.77	9.62	0.1107918	25.7590935	2.57590935	0.1090908	25.363611	2.5363611	0.068646312	0.067592376	0.009411	0.00926604	0.00094	0.000927
20398	5937.50	10.65	10.74	5925	5915		11.85	11.76	0.134379	31.2431175	3.12431175	0.1333584	31.005828	3.1005828	0.083260879	0.082628518	0.000973	0.00096589		
20298	5935.58	9.68	8.01	5920	5925		0.90	2.57	0.010206	2.372895	0.2372895	0.0291438	6.7759335	0.67759335	0.006323611	0.018057423	1.34E-05	3.8379E-05		
20198	5934.37	2.42	2.21	5915	5925		6.95	7.16	0.078813	18.3240225	1.83240225	0.0811944	18.877698	1.8877698	0.04883233	0.050307839	0	0		
20098	5932.55	10.51	7.95	5915	5911		11.04	13.60	0.1251936	29.107512	2.9107512	0.154224	35.85708	3.585708	0.077569629	0.09555679	0.001236	0.00152321		
22198	5931.60	10.96	10.35	5910	5915	N	5.64	6.25	0.0639576	14.870142	1.4870142	0.070875	16.4784375	1.64784375	0.039627963	0.043913966	0	0		
22298	5930.60	13.88	11.13	5910	5915		1.72	4.47	0.0195048	4.534866	0.4534866	0.0506898	11.7853785	1.17853785	0.012085123	0.031407268	0	0		
						NP = the well did not penetrate bedrock														
T =	is the procuct of the saturated thickness for individual wells and the hydraulic conductivity																			
												Totals for TCE Plume			0.141719151	0.156052669	0.009432	0.01049394	0.00094	0.001049
Q =	TL(dh/dl)	Using average in-plume Transmissivity (T) values above:																		
												Totals for Carbon tet Plume			0.30346307	0.335643224	0.132997	0.15991325	0.0133	0.015991
X =	T(dh/dl)C	g/day/ft	*Contaminant load equals transmissivity times hydraulic gradient times concentration*																	
		Unit conversion: T(sq.ft/day) x dh/dl (unitless) x C (ug/L) x 28.32 L/cu.ft x 10-6 g/ug =TC (g/(day/ft)										Totals for vinyl chloride plume			0.083752716	0.093448919	0.009908	0.01017347	0.00099	0.001017
			C	is taken as the Total VOC concentration from Table 4-1																
F =	XL	*Contaminant Flux equals Contaminant Load times Length. L = 100 feet for each well*																		
Hydraulic Conductivity																				
for Colluvium		Min	Max	Geometric Mean																
in cm/sec		4.0E-06	9.3E-04	9.3E-05																
DH: measured water elevation between well 22896 and creek elevation below 21598																				
in feet		22896	Creek elevation		DH															
		5980.52	5960		20.52	feet														
DL: measured distance between well 22896 and creek below 21598																				
in feet					DL															
					400	feet														
DH/DL =	0.0513																			

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but the well is located in an area of artificial fill and where the stream is in a culvert, so the well may not be representative of natural hydrologic conditions. This small tributary stream receives influent from a number of pipes and culverts which may serve to dilute the effects of any groundwater recharge to the stream.

The line of Geoprobe wells appears to have adequately characterized the nature and extent of groundwater contamination in the area of the tributary drainage. Additional evaluation may be necessary to establish pathways for the carbon tet plume to the east and north of IHSS 118.1. There is evidence that a portion of the carbon tet plume has moved eastward from the source and possibly intermingled with another VOC plume north of Building 779. Also, well P219189 has carbon tet above action levels which may suggest a pathway from the carbon tet plume to the north. The current well installation program for the D&D monitoring of Building 771 may add information on the extent of the carbon tet plume. In addition, a well installation program is also planned for Building 776/777 D&D monitoring in FY00 which should help define potential pathways for groundwater contamination.

The cumulative contaminant flux to surface water from the three groundwater plume areas defined amounts to approximately 14 grams per day. Given the low flow from the outfall pipe that did show detections for VOCs it can be assumed that this pathway provides little added impact to surface water if the pipe is not being used. Efforts will be made to ascertain whether this outfall has been abandoned and whether it is capable of higher flow rates at certain times of the year.

4.2 PU&D Yard Plume Investigations

In 1997, the Site conducted a field investigation into the nature and extent of VOC groundwater contamination found in upgradient monitoring wells at the Present Sanitary Landfill. This investigation resulted in the identification of the PU&D Yard as the probable source area and implicated the landfill groundwater intercept and diversion system as an important factor in contributing to longitudinal plume spreading (Figure 4-7). The results of this evaluation were summarized in the 1997 Annual RFCA Groundwater Monitoring Report (DOE, 1998). Further investigation into the function of the groundwater intercept and diversion system and it's possible role in collecting and discharging PU&D Yard plume contaminants downgradient of the landfill were undertaken in 1998. This section summarizes the results of the 1998 investigation, including field observations of drain valving, flow, and analytical results of samples collected at the drain outfalls in 1998 and 1999.

Figure 4-8 illustrates the layout of the groundwater intercept and diversion system. Information presented in the *Phase I RFI/RI Work Plan for Operable Unit No. 7 - Present Sanitary Landfill* (DOE, 1991) and other Operable Unit 7 documentation contain engineering design specifications and a hydrologic analysis of system effectiveness, but contain little information on system operation, such as valving configurations and discharge data. Discharge at drain outfalls SW099 and SW100 located below the landfill pond dam is usually minimal or absent despite evidence, such as an abundance of valley head-cut seeps in pre-landfill aerial photographs, that suggest flow should be greater than currently observed assuming proper drain function. Explanations for the lack of appreciable discharge at these outfalls involve at least four scenerios: 1) discharge is currently routed toward the landfill pond by valving and piping shown in design drawings, 2) the lines have been broken or breached during normal landfill operations resulting in subsurface releases of drain water to refuse materials, 3) the drain system was never properly functional because of leakage caused by geological irregularities, design or installation flaws, or other potential shortcomings, and 4) groundwater levels at the perimeter of the landfill drop below the elevation of the groundwater diversion system drainpipe during extended periods during the year.

For these reasons, a preliminary investigation into drain operation was undertaken to gain additional information on the fate of groundwater collected by the system. This investigation consisted of a records search to uncover additional documentation on the historical operation and valve configuration; a field search to locate valves, drain line locations, and drain outfall locations at the landfill pond; and a monitoring program for sampling groundwater flow issuing from SW099 and SW100.

A records search resulted in the disclosure of no new information relevant to drain operation beyond that contained within DOE (1991). The field survey, however, was more successful resulting in the location of valving for both the north and south intercept lines, the location of apparent pond line locations indicated by subtle changes in topography and vegetation leading from the valves, and location of the south pond drain outfall during a period of low pond stage (May 1999). Significantly, no discharge was observed at this outfall during a time when SW099 and SW100 were both flowing.

Observation of drain outfalls SW099 and SW100, located on Figure 4-8, was conducted at roughly monthly intervals during the Fall and Winter of 1998, and Spring of 1999. In December 1998, a sufficient amount of flow was observed at SW099 (0.007 gallons per minute [gpm] on 12/18/98) to justify sampling for VOCs. The SW100 outfall was dry during all site visits prior to April 1999, except for incident precipitation which had built up inside the weir box. On April 29, 1999, flows from both outfalls were observed and a complete sample set was collected for VOCs, metals, radionuclides (Pu-239/240, Am-241, uranium isotopes, and tritium), and water quality parameters (total dissolved solids, sulfate, fluoride, and nitrate/nitrite). Discharges of 0.5 gpm at SW099 and 1.3 gpm at SW100 were measured prior to sampling.

Table 4-3 presents the analytical results of the 1998 and 1999 sampling events at SW099 and SW100. VOCs characteristic of PU&D Yard groundwater contamination were not detected in samples collected at either outfall. Dissolved metals, water quality constituents, Pu-239/240, Am-241, and tritium were all found below Tier II action levels. The uranium isotope U-233/234 was detected above the Tier II action level at 1.2991 pCi/L in SW100, but below the Tier II action level at SW099 (0.9358 pCi/L). U-235 was detected below the Tier II action level and U-238 was detected above the Tier II action level at both locations. In all cases, the reported uranium isotope activities were well below their respective background M2SD activities and, as such, are not reportable values. The information collected thus far indicates that the PU&D Yard VOC plume does not contribute significant concentrations of contaminants to the landfill groundwater intercept and diversion system. Monitoring of the drain outfalls will be continued in 1999 to further investigate the potential impact of PU&D Yard contamination on groundwater and surface water quality downgradient of the landfill.

4.3 Carbon Tetrachloride Plume

This section summarizes the progress on the IHSS 118.1 carbon tetrachloride plume natural attenuation study, which was initiated in FY99. The object of this report is to provide sample results for the suite of analytes that were sampled in the first sampling round and determine whether the suite should be modified given the results obtained. The overall goal of the project is to characterize the potential for natural attenuation as a significant factor in the remediation strategy for the IHSS 118.1 Dense Non-Aqueous Phase Liquid (DNAPL) source. Carbon tet is the main contaminant of concern at IHSS 118.1 and is the result of spills related to a carbon tet storage tank, which has been subsequently removed. Characterization work was initiated in 1997 to identify the extent of the DNAPL source and determine the feasibility of extracting the DNAPL through pumping or excavation. Source removal was postponed because it is presently unfeasible to excavate the source due to the number of active process pipes that run through the source area. The decision was then made to evaluate the potential for the carbon tet plume to be effected by natural attenuation processes.

Table 4-3 Groundwater Intercept System Analytical Data
Present Sanitary Landfill/PU&D Yard

Location	Sample Date	Sample #	Analyte	Result	Units	Lab Qualifier	Detection Limit	Validation Qualifier
SW099	4/29/99	GW06353TE	FLUORIDE	0.4	MG/L		0.05	
SW099	4/29/99	GW06353TE	NITRATE/NITRITE	0.19	MG/L		0.05	
SW099	4/29/99	GW06353TE	SULFATE	40	MG/L		1	
SW099	4/29/99	GW06353TE	TOTAL DISSOLVED SOLIDS	380	MG/L		10	
SW100	4/29/99	GW06354TE	FLUORIDE	0.41	MG/L		0.05	
SW100	4/29/99	GW06354TE	NITRATE/NITRITE	0.05	MG/L	U	0.05	
SW100	4/29/99	GW06354TE	SULFATE	58	MG/L		1	
SW100	4/29/99	GW06354TE	TOTAL DISSOLVED SOLIDS	260	MG/L		10	
SW099	12/30/98	GW06198TE	1,1,1,2-TETRACHLOROETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,1,1-TRICHLOROETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,1,2,2-TETRACHLOROETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,1,2-TRICHLOROETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,1-DICHLOROETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,1-DICHLOROETHENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,1-DICHLOROPROPENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,2,3-TRICHLOROBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,2,3-TRICHLOROPROPANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,2,4-TRICHLOROBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,2-DIBROMOETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,2-DICHLOROBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,2-DICHLOROETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,2-DICHLOROPROPANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,3-DICHLOROBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,3-DICHLOROPROPANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	1,4-DICHLOROBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	2,2-DICHLOROPROPANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	4-ISOPROPYLTOLUENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	BENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	BENZENE, 1,2,4-TRIMETHYL	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	BENZENE, 1,3,5-TRIMETHYL-	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	BROMOBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	BROMOCHLOROMETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	BROMODICHLOROMETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	BROMOFORM	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	BROMOMETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	CARBON TETRACHLORIDE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	CHLOROBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	CHLOROETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	CHLOROFORM	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	CHLOROMETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	cis-1,2-DICHLOROETHENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	cis-1,3-DICHLOROPROPENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	DIBROMOCHLOROMETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	DIBROMOMETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	DICHLORODIFLUOROMETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	ETHYLBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	HEXACHLOROBUTADIENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	ISOPROPYLBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	METHYLENE CHLORIDE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	NAPHTHALENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	n-BUTYLBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	n-PROPYLBENZENE	1	UG/L	U	1	

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Table 4-3 Groundwater Intercept System Analytical Data
Present Sanitary Landfill/PU&D Yard

Location	Sample Date	Sample #	Analyte	Result	Units	Lab Qualifier	Detection Limit	Validation Qualifier
SW099	12/30/98	GW06198TE	o-CHLOROTOLUENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	p-CHLOROTOLUENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	PROPANE, 1,2-DIBROMO-3-CHLORO-	1	UG/L	U	1	R1
SW099	12/30/98	GW06198TE	sec-BUTYLBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	STYRENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	tert-BUTYLBENZENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	TETRACHLOROETHENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	TOLUENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	TOTAL XYLENES	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	trans-1,2-DICHLOROETHENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	trans-1,3-DICHLOROPROPENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	TRICHLOROETHENE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	TRICHLOROFLUOROMETHANE	1	UG/L	U	1	
SW099	12/30/98	GW06198TE	VINYL CHLORIDE	1	UG/L	U	1	
SW099	4/29/99	GW06353TE	1,1,1,2-TETRACHLOROETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,1,1-TRICHLOROETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,1,2,2-TETRACHLOROETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,1,2-TRICHLOROETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,1-DICHLOROETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,1-DICHLOROETHENE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,1-DICHLOROPROPENE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,2,3-TRICHLOROBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	1,2,3-TRICHLOROPROPANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,2,4-TRICHLOROBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	1,2-DIBROMOETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,2-DICHLOROBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	1,2-DICHLOROETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,2-DICHLOROPROPANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,3-DICHLOROBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	1,3-DICHLOROPROPANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	1,4-DICHLOROBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	2,2-DICHLOROPROPANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	4-ISOPROPYLTOLUENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	BENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	BENZENE, 1,2,4-TRIMETHYL	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	BENZENE, 1,3,5-TRIMETHYL-	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	BROMOBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	BROMOCHLOROMETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	BROMODICHLOROMETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	BROMOFORM	0.1	UG/L	J	1	V1
SW099	4/29/99	GW06353TE	BROMOMETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	CARBON TETRACHLORIDE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	CHLOROBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	CHLOROETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	CHLOROFORM	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	CHLOROMETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	cis-1,2-DICHLOROETHENE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	cis-1,3-DICHLOROPROPENE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	DIBROMOCHLOROMETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	DIBROMOMETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	DICHLORODIFLUOROMETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	ETHYLBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	HEXACHLOROBUTADIENE	1	UG/L	U	1	V1

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Table 4-3 Groundwater Intercept System Analytical Data
Present Sanitary Landfill/PU&D Yard

Location	Sample Date	Sample #	Analyte	Result	Units	Lab Qualifier	Detection Limit	Validation Qualifier
SW099	4/29/99	GW06353TE	ISOPROPYLBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	METHYLENE CHLORIDE	0.09	UG/L	BJ	1	JB1
SW099	4/29/99	GW06353TE	NAPHTHALENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	n-BUTYLBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	n-PROPYLBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	o-CHLOROTOLUENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	p-CHLOROTOLUENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	PROPANE, 1,2-DIBROMO-3-CHLORO-	1	UG/L	U	1	R1
SW099	4/29/99	GW06353TE	sec-BUTYLBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	STYRENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	tert-BUTYLBENZENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	TETRACHLOROETHENE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	TOLUENE	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	TOTAL XYLENES	1	UG/L	U	1	UJ1
SW099	4/29/99	GW06353TE	trans-1,2-DICHLOROETHENE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	trans-1,3-DICHLOROPROPENE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	TRICHLOROETHENE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	TRICHLOROFLUOROMETHANE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	VINYL CHLORIDE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,1,1,2-TETRACHLOROETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,1,1-TRICHLOROETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,1,2,2-TETRACHLOROETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,1,2-TRICHLOROETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,1-DICHLOROETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,1-DICHLOROETHENE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,1-DICHLOROPROPENE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,2,3-TRICHLOROBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	1,2,3-TRICHLOROPROPANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,2,4-TRICHLOROBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	1,2-DIBROMOETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,2-DICHLOROBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	1,2-DICHLOROETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,2-DICHLOROPROPANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,3-DICHLOROBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	1,3-DICHLOROPROPANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	1,4-DICHLOROBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	2,2-DICHLOROPROPANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	4-ISOPROPYLTOLUENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	BENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	BENZENE, 1,2,4-TRIMETHYL	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	BENZENE, 1,3,5-TRIMETHYL-	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	BROMOBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	BROMOCHLOROMETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	BROMODICHLOROMETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	BROMOFORM	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	BROMOMETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	CARBON TETRACHLORIDE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	CHLOROBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	CHLOROETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	CHLOROFORM	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	CHLOROMETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	cis-1,2-DICHLOROETHENE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	cis-1,3-DICHLOROPROPENE	1	UG/L	U	1	V1

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Table 4-3 Groundwater Intercept System Analytical Data
Present Sanitary Landfill/PU&D Yard

Location	Sample Date	Sample #	Analyte	Result	Units	Lab Qualifier	Detection Limit	Validation Qualifier
SW100	4/29/99	GW06354TE	DIBROMOCHLOROMETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	DIBROMOMETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	DICHLORODIFLUOROMETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	ETHYLBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	HEXACHLOROBUTADIENE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	ISOPROPYLBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06353TE	METHYLENE CHLORIDE	0.1	UG/L	JB	1	JB1
SW100	4/29/99	GW06354TE	NAPHTHALENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	n-BUTYLBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	n-PROPYLBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	o-CHLOROTOLUENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	p-CHLOROTOLUENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	PROPANE, 1,2-DIBROMO-3-CHLORO-	1	UG/L	U	1	R1
SW100	4/29/99	GW06354TE	sec-BUTYLBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	STYRENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	tert-BUTYLBENZENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	TETRACHLOROETHENE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	TOLUENE	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	TOTAL XYLENES	1	UG/L	U	1	UJ1
SW100	4/29/99	GW06354TE	trans-1,2-DICHLOROETHENE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	trans-1,3-DICHLOROPROPENE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	TRICHLOROETHENE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	TRICHLOROFLUOROMETHANE	1	UG/L	U	1	V1
SW100	4/29/99	GW06354TE	VINYL CHLORIDE	1	UG/L	U	1	V1
SW099	4/29/99	GW06353TE	Aluminum	8.1	UG/L	B	5	
SW099	4/29/99	GW06353TE	Antimony	0.98	UG/L	B	0.48	
SW099	4/29/99	GW06353TE	Arsenic	0.58	UG/L	U	0.58	
SW099	4/29/99	GW06353TE	Barium	166	UG/L		0.05	
SW099	4/29/99	GW06353TE	Beryllium	0.02	UG/L	U	0.02	
SW099	4/29/99	GW06353TE	Cadmium	0.08	UG/L	U	0.08	
SW099	4/29/99	GW06353TE	Calcium	87000	UG/L		4.1	
SW099	4/29/99	GW06353TE	Chromium	0.3	UG/L	B	0.15	
SW099	4/29/99	GW06353TE	Cobalt	0.18	UG/L	U	0.18	
SW099	4/29/99	GW06353TE	Copper	2.1	UG/L	B	0.25	
SW099	4/29/99	GW06353TE	Iron	15.2	UG/L	B	4.8	
SW099	4/29/99	GW06353TE	Lead	0.72	UG/L	U	0.72	
SW099	4/29/99	GW06353TE	Lithium	4	UG/L	B	0.05	
SW099	4/29/99	GW06353TE	Magnesium	11800	UG/L		0.7	
SW099	4/29/99	GW06353TE	Manganese	1.1	UG/L	B	0.05	
SW099	4/29/99	GW06353TE	Mercury	0.1	UG/L	U	0.1	
SW099	4/29/99	GW06353TE	Molybdenum	0.88	UG/L	B	0.3	
SW099	4/29/99	GW06353TE	Nickel	1.5	UG/L	B	0.3	
SW099	4/29/99	GW06353TE	Potassium	869	UG/L	B	7	
SW099	4/29/99	GW06353TE	Selenium	1.2	UG/L	U	1.2	
SW099	4/29/99	GW06353TE	Silver	0.35	UG/L	U	0.35	
SW099	4/29/99	GW06353TE	Sodium	18000	UG/L		10.5	
SW099	4/29/99	GW06353TE	Strontium	464	UG/L		0.02	
SW099	4/29/99	GW06353TE	Thallium	0.88	UG/L	U	0.88	
SW099	4/29/99	GW06353TE	Tin	0.68	UG/L	U	0.68	
SW099	4/29/99	GW06353TE	Vanadium	1.6	UG/L	B	0.2	
SW099	4/29/99	GW06353TE	Zinc	4.8	UG/L	B	0.12	
SW100	4/29/99	GW06354TE	Aluminum	155	UG/L		5	

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Table 4-3 Groundwater Intercept System Analytical Data
Present Sanitary Landfill/PU&D Yard

Location	Sample Date	Sample #	Analyte	Result	Units	Lab Qualifier	Detection Limit	Validation Qualifier
SW100	4/29/99	GW06354TE	Antimony	0.48	UG/L	U	0.48	
SW100	4/29/99	GW06354TE	Arsenic	0.65	UG/L	B	0.58	
SW100	4/29/99	GW06354TE	Barium	63.8	UG/L	B	0.05	
SW100	4/29/99	GW06354TE	Beryllium	0.02	UG/L	U	0.02	
SW100	4/29/99	GW06354TE	Cadmium	0.08	UG/L	U	0.08	
SW100	4/29/99	GW06354TE	Calcium	50500	UG/L		4.1	
SW100	4/29/99	GW06354TE	Chromium	0.42	UG/L	B	0.15	
SW100	4/29/99	GW06354TE	Cobalt	0.18	UG/L	U	0.18	
SW100	4/29/99	GW06354TE	Copper	2.9	UG/L	B	0.25	
SW100	4/29/99	GW06354TE	Iron	104	UG/L		4.8	
SW100	4/29/99	GW06354TE	Lead	0.72	UG/L	U	0.72	
SW100	4/29/99	GW06354TE	Lithium	3.6	UG/L	B	0.05	
SW100	4/29/99	GW06354TE	Magnesium	9120	UG/L		0.7	
SW100	4/29/99	GW06354TE	Manganese	2.3	UG/L	B	0.05	
SW100	4/29/99	GW06354TE	Mercury	0.1	UG/L	U	0.1	
SW100	4/29/99	GW06354TE	Molybdenum	0.91	UG/L	B	0.3	
SW100	4/29/99	GW06354TE	Nickel	1.4	UG/L	B	0.3	
SW100	4/29/99	GW06354TE	Potassium	3070	UG/L	B	7	
SW100	4/29/99	GW06354TE	Selenium	10.9	UG/L		1.2	
SW100	4/29/99	GW06354TE	Silver	0.35	UG/L	U	0.35	
SW100	4/29/99	GW06354TE	Sodium	19900	UG/L		10.5	
SW100	4/29/99	GW06354TE	Strontium	309	UG/L		0.02	
SW100	4/29/99	GW06354TE	Thallium	0.88	UG/L	U	0.88	
SW100	4/29/99	GW06354TE	Tin	0.68	UG/L	U	0.68	
SW100	4/29/99	GW06354TE	Vanadium	1.1	UG/L	B	0.2	
SW100	4/29/99	GW06354TE	Zinc	10.8	UG/L	B	0.12	
SW099	4/29/99	GW06353TE	Americium-241	0.0179	PCI/L	J	0.0144	V1
SW099	4/29/99	GW06353TE	Plutonium-239/240	0.0065	PCI/L	U	0.0185	V1
SW099	4/29/99	GW06353TE	Uranium-233/234	1.2991	PCI/L		0.1595	
SW099	4/29/99	GW06353TE	Uranium-235	0.1085	PCI/L	U	0.1421	
SW099	4/29/99	GW06353TE	Uranium-238	1.143	PCI/L		0.1195	
SW100	4/29/99	GW06354TE	Americium-241	0.0106	PCI/L	J	0.0057	V1
SW100	4/29/99	GW06354TE	Plutonium-239/240	0.0107	PCI/L	J	0.0058	V1
SW100	4/29/99	GW06354TE	Uranium-233/234	0.9358	PCI/L	J	0.0528	
SW100	4/29/99	GW06354TE	Uranium-235	0.0203	PCI/L	U	0.1418	
SW100	4/29/99	GW06354TE	Uranium-238	0.7751	PCI/L	J	0.0973	

A drilling and sampling program was designed to collect the data necessary for decision making with respect to natural attenuation. Eight wells were installed in a pattern so as to have two wells upgradient of the DNAPL source (18799, 18899), three wells along an east-west line where two wells were in the source, and one well located cross gradient to the source (18499, 18599, and 18699). The remaining three wells were installed in a line approximately 60 –70 feet downgradient from the source (18199, 18299, 18399). The wells were installed in February 1999 and the first round of sampling was completed by the end of March. In addition, VOC samples were collected from DNAPL in well 05497. Figure 4-9 shows the location of the wells and sampling locations.

The wells were installed with bladder pumps so that samples could be collected with aeration of the sample kept at a minimum. This is important when collecting VOC samples and when measuring dissolved oxygen (DO) and oxidation reduction potential (redox) parameters. A flow-through cell containing the field parameter probes was used for collection of temperature, DO, redox, alkalinity, specific conductance and pH. A HACH spectrophotometer was used to measure ferrous iron. All other samples were sent to off-site laboratories for analysis. Full suites were obtained from seven of the eight wells. Upgradient well 18899 was dry and could not be sampled. Table 4.4 lists the analyses performed for the IHSS 118.1 study as listed in the IHSS 118.1 Sampling and Analysis Plan (RMRS, 1998). Water levels were obtained for all wells in the project. After additional sampling rounds are completed, the data will be presented in a Data Summary Report.

4.3.1.1 Footing Drain Outfall Samples

Two outfall pathways were sampled that are associated with the Building 771 footing drain system. Building 771 is located approximately 120 feet due north of IHSS 118.1 and has a footing drain system that collects groundwater from the south side of the building. Because the footing drain system is downgradient of the carbon tet groundwater plume, it was important to sample the outfalls from this system to determine if significant concentrations of VOCs were present. Figure 4-9 shows the location of the sample locations. One outfall is located to the west of Building 771 and flows to a small stream which enters North Walnut Creek to the north. This outfall could be sampled directly at it's terminus on the hillside, and has a location name of 771-FDOUT2. The other outfall is believed to be located under the North Perimeter road and probably enters North Walnut Creek. The pipeline to this outfall extends out from the northwest corner of Building 771 and has two manholes that were available for sampling. Sample location 771-Manhole3 is a manhole accessing the outfall pipeline outside Building 771. The second location (NW771-Manhole) is located at the confluence of drain pipes near the north perimeter road.

Table 4- 4. Sample Types/Analytical Methods

Line Item Code	Analytes	Analytical Method	Media Type	Container	Preservative	Comments/Holding Time
SS01B005	Volatile Organic Compounds	SW-846 Method 8260	Water	2 x 40 ml VOA vials - Teflon lined septa lids	Cool, 4° C, HCl	Zero head space 14 day hold time
SS01B006	Volatile Organic Compounds	SW-846 Method 8260	Soil, Waste	60-ml wide mouth glass jar with Teflon lined lid	Cool, 4°C,	Zero head space 14 day hold time
SS02B006	Semivolatiles	SW-846 Method 8270B	Water	3-liter glass jar	Cool, 4°C	7 day hold time
SS02B006	Semivolatiles	SW-846 Method 8270B	Soil	250-ml wide mouth glass jar with Teflon lined lid	Cool, 4° C	14 days to extraction, 40 days from extraction to analysis
RC01B0003	Americium, Plutonium & Uranium	ASD SOW for Isotopics RC01	Soil	125-g wide mouth glass jar	Cool, 4° C	
OS01A002	Gross Alpha/Beta	ASD SOW for Isotopics RC01 Module OS01A	Water	1 liter plastic bottle	Cool, 4° C	
OS01A003	Gross Alpha/Beta	ASD SOW for Isotopics RC01 Module OS01A	Soil	60-g wide mouth glass jar	Cool, 4° C	
SS06B037	Sulfates	SW-846, 9035, 9036	Water	1 liter plastic bottle	Cool, 4° C	Sulfates, Sulfites and Alkalinity come from same bottle 28 day hold time
SS06B039	Sulfides	SW-846 9030A	Water	1 liter plastic bottle	Cool, 4° C	Sulfates, Sulfites and Alkalinity come from same bottle 7 day hold time
SS06B002	Alkalinity	SW-846 310.1, 320.2	Water	1 Liter plastic bottle	Cool, 4° C	Sulfates, Sulfites and Alkalinity come from same bottle 14 day hold time
SS06B020	Nitrates	SW-846 , 300.0	Water	1 liter plastic bottle	Cool, 4° C	48 day hold time
SS06B025	Total Organic Carbon	SW-846 415.1	Water	1 liter plastic bottle	Cool, 4° C pH<2 w/HCl	28 day hold time
SS06B024	Dissolved Organic Carbon	SW-846 415.1	Water	1 liter plastic bottle	Cool, 4° C	28 day hold time
SS06B010	Chlorides	E300.0	Water	100 ml. plastic bottle	None	28 day hold time
Field	pH	SW9040	Water			
Field	Dissolved Oxygen	E360.1	Water			
Field	Oxidation-Reduction Potential	ASTM D1498	Water			
Field	Temperature	E170.1	Water			
Field	Conductivity	SW9050	Water			

For purposes of this preliminary evaluation, three of the seven wells were chosen for discussion. Well 18799 is the only upgradient well that had water, so it is used for background comparison. Well 18499 is in a line due north of 18799 and is in the DNAPL source. Samples were collected above the DNAPL in the well. Well 18199 is a downgradient well due north of well 18499. These wells comprise a representative cross section of groundwater quality across the IHSS 118.1 site. In most cases, data from the other wells conform to those found in this subset. Charts were derived to show the relative changes in water quality across the IHSS. Reference Appendix A from document RF/RMRS-98-420.UN, *Status Report for Monitoring of Natural Attenuation at IHSS 118.1,* for the analytical results obtained from the wells. Evaluation of the various parameters used for the natural attenuation project leads to a number of conclusions with regard to whether the parameters are necessary for the continued tracking of VOC degradation.

4.3.1.2 Natural Attenuation

Natural attenuation is defined as the observed reduction in contaminant concentrations as contaminants migrate from the source in environmental media. This reduction in concentration can be due to a number of fate and transport processes in groundwater including, dilution, dispersion, sorption, volatilization and biotic and abiotic transformations. Biodegradation or bioremediation is used to describe the portion of natural attenuation that is brought about by biological degradation mechanisms. Biological degradation typically involves bacteria that occur naturally in the soil and groundwater. Under the right conditions these bacteria can break down certain fuel hydrocarbons and certain chlorinated organic compounds.

The main mechanism for the biological breakdown of chlorinated organics is through reductive dechlorination reactions. Under reductive dechlorination, a chlorinated organic compound such as carbon tet is used as an electron acceptor, which causes the compound to gain a hydrogen atom at the expense of a chlorine atom. The dechlorination of carbon tet would cause chloroform, methylene chloride and chloromethane to sequentially form as chlorine is progressively removed from the original carbon tet compound.

For biodegradation to occur there must be an electron acceptor, a source of carbon to serve as an electron donor and a favorable environment in the aquifer for the metabolic reactions to take place. The IHSS 118.1 sampling program was designed to provide evidence that these processes are taking place. Wiedemeier et al (1996) have developed a simple system for determining whether biodegradation is occurring at a site based on applying scores to the chemical parameters discussed in this report. The criteria used is summarized in Table 4.5. A score of 0 to 5 points is suggestive of inadequate

Table 4-5
Checklist for Determination of Biodegradation

Analyte	Concentration in most contaminated zone	Significance	Points	HSS 118.1 in Source	IHSS 118.1 Outside sourc
Oxygen	< 0.5 mg/L	Tolerated at this concentration	3	3	0
Oxygen	> 1.0 mg/L	Prohibits reductive dechlorination	-3	0	-3
Nitrate	< 1.0 mg/L	Competes with reductive pathway at higher concentrations	2	2	0
Ferrous Iron	> 1.0 mg/L	Reductive pathway possible	3	3	0
Sulfate	< 20 mg/L	Competes with reductive pathway at higher concentrations	2	0	0
Sulfide	> 1.0 mg/L	Reductive pathway possible	3	0	0
Methane	> 0.1 mg/L	Ultimate reductive daughter product	2	2	0
Redox	< 50 mV	Reductive pathway possible	1	1	0
	< -100 mV	Reductive pathway more possible	2	0	0
DOC	> 20 mg/L	Carbon and energy source - drives dechlorination	2	0	0
Temperature	> 20 degrees C	Biochemical process accelerated	1	0	0
Carbon Dioxide	> 2x background	Ultimate oxidative daughter product	1	na	na
Alkalinity	> 2x background	Results from interaction of CO2 with aquifer	1	1	0
Chloride	> 2x background	Daughter product of organic chlorine	2	0	0
Hydrogen	> 2 nM	Reductive pathway possible	3	na	na
Chloroform	Present	Daughter product of Carbon Tet.	2	2	2
Methlyene Chloride	Present	Daughter product of Chloroform.	2	2	2
Chloromethane	Present	Daughter product of Methylene Chloride	2	2	2
			Score	18	3
na - not analyzed					


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evidence of biodegradation. A score of 6 to 14 suggests limited evidence of biodegradation, a score of 15 to 20 shows adequate evidence and scores above 20 show strong evidence of biodegradation.

4.3.2 Electron Donors

The process of natural attenuation that would degrade chlorinated organic compounds like carbon tet is reductive dechlorination. Reductive dechlorination is the substitution of hydrogen for chlorine atoms within the chlorinated organic compound, which causes it to progressively break down into daughter products. This process requires that there be a source of electron donors, which is typically organic carbon. Carbon can be utilized either as natural carbon in the aquifer, or can be acquired from the breakdown of petroleum hydrocarbons. The following analyses were performed to determine available electron donor activity at IHSS 118.1.

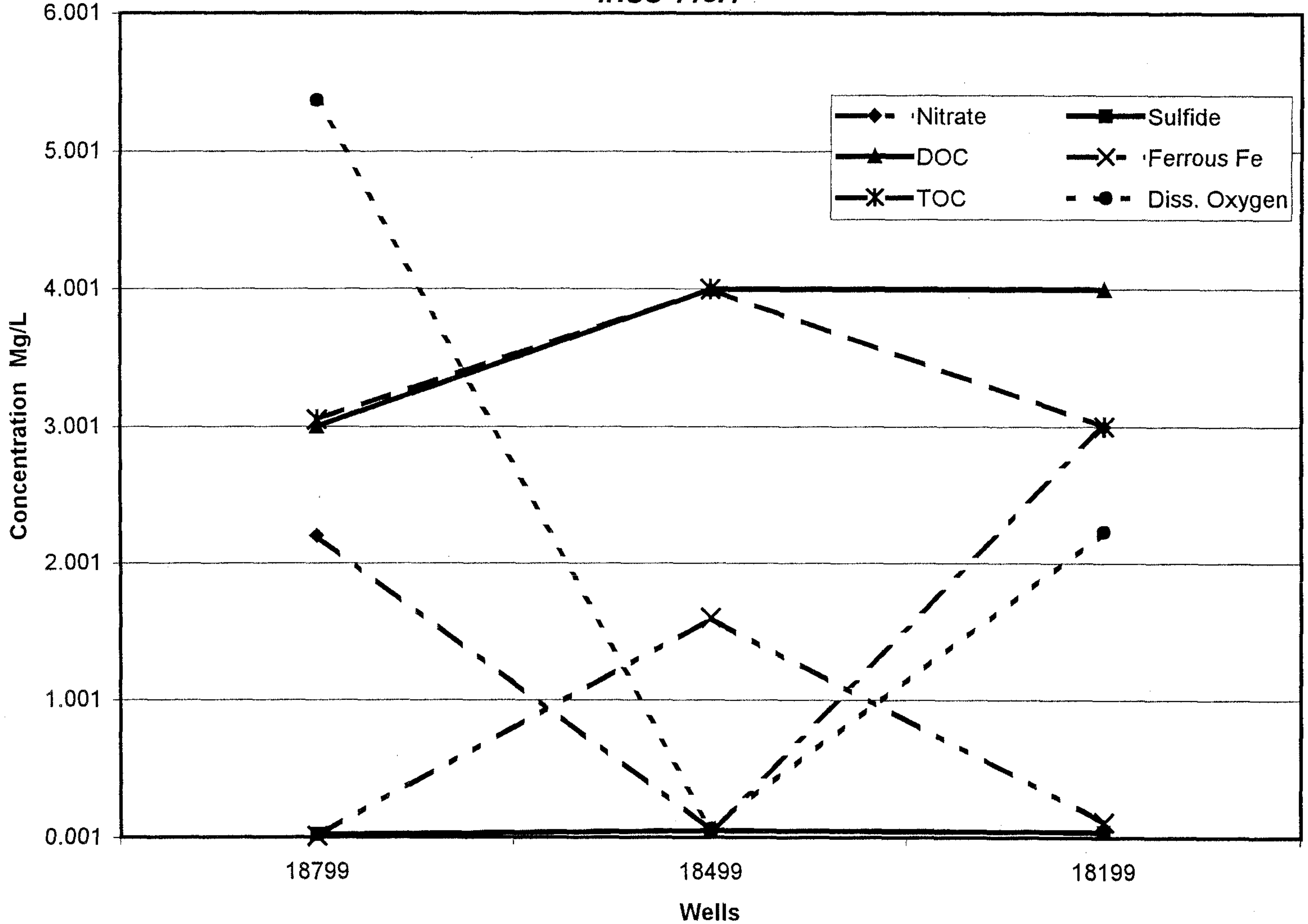
4.3.2.1 Semivolatile Organic Suite

The semivolatile organic suite was collected because of a perception that there had been a diesel spill in the area of IHSS 118.1. Diesel by-products could supply the electron donors that are necessary for reductive dechlorination of the carbon tet and breakdown products. Diesel fuel is composed of such indicator compounds as napthalene, phenanthrene, anthracene, chrysene etc., as opposed to the BTEX compounds (benzene, toluene, ethylbenzene and xylenes) which are common in gasoline. Based on the data collected, there is no evidence of either diesel or gasoline indicator compounds in the vicinity of IHSS 118.1. Therefore, it may be prudent to discontinue the semivolatile analyte suite after one more round of sampling.

4.3.2.2 Total Organic Carbon and Dissolved Organic Carbon

Total organic carbon (TOC) and dissolved organic carbon (DOC) were collected to ascertain the availability of carbon in the environment to serve as an energy source for reductive dechlorination. Figure 4-10 shows that both DOC and TOC are within the 3-4 mg/L range. Wiedemeier et al (1996), suggest that DOC above 20 mg/L assures that enough carbon is present to drive dechlorination. Therefore the limited amount of carbon in groundwater may be retarding the rate of reductive dechlorination at IHSS 118.1. With respect to further sampling, the Wiedemeier paper uses DOC as an indicator parameter, but does not discuss TOC. Given the similarity in concentration, it is suggested that only DOC be sampled after one more sample round.

Figure 4-10
Nitrate, DOC, TOC, Sulfide, Ferrous Iron and DO Concentrations at IHSS 118.1



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4.3.3 Electron Acceptors

In order to effect reductive dechlorination of chlorinated organic solvents, the solvents must be able to be electron acceptors. This process occurs when there are sufficient electron donor sources present, the proper chemical environment exists, and a lack of other electron acceptors that would compete with the solvent compounds as electron acceptors.

4.3.3.1 Carbon Tetrachloride

Carbon tetrachloride is the dominant organic compound found in IHSS 118.1. If biodegradation is occurring by reductive dechlorination, carbon tet would breakdown progressively to chloroform, dichloromethane, chloromethane, and ultimately to carbon dioxide and water. If reductive dechlorination was occurring, carbon tet would be seen to progressively decrease in concentration with time as the breakdown products increased in concentration. Downgradient wells would also reflect an increase in breakdown products relative to carbon tet. Figures 4-11 and 4-12 show the trends in carbon tet and daughter species. The sample from the pipe outfall near 771 is also included. In Figure 4-11 carbon tet can be seen to decrease in concentration from the source to downgradient well 18199. This would be expected if biodegradation was occurring. However the trends in chloroform and chloromethane do not increase in downgradient well 18199. Methylene chloride exhibits a similar behavior, but must be viewed with caution because it is a common lab contaminant and some was reported in the lab blank. The data suggest that there are daughter products from reductive dechlorination of carbon tet in the source area, but increased breakdown downgradient of the source is not readily apparent. By looking at the ratio of daughter products to carbon tet with time, a better indication of in-source biodegradation would be obtained. Therefore, it is suggested that sampling for these compounds continue for a sufficient time period to establish a rate of breakdown at the source. The Building 771 outfall locations described above were also sampled for the VOC suite. Location 771-FDOUT2 shows a carbon tet concentration of 12 ug/L and a chloroform concentration of 23 ug/L. The outfall has a very low flow, which suggests that it may be shut off. Because carbon tet and chloroform are the dominant components of the carbon tet plume, it appears that some of the plume is being collected in the footing drain system. The other two sample locations showed no significant VOC detections.

Figure 4-11
Carbon Tetrachloride and Chloroform Concentrations at IHSS 118.1

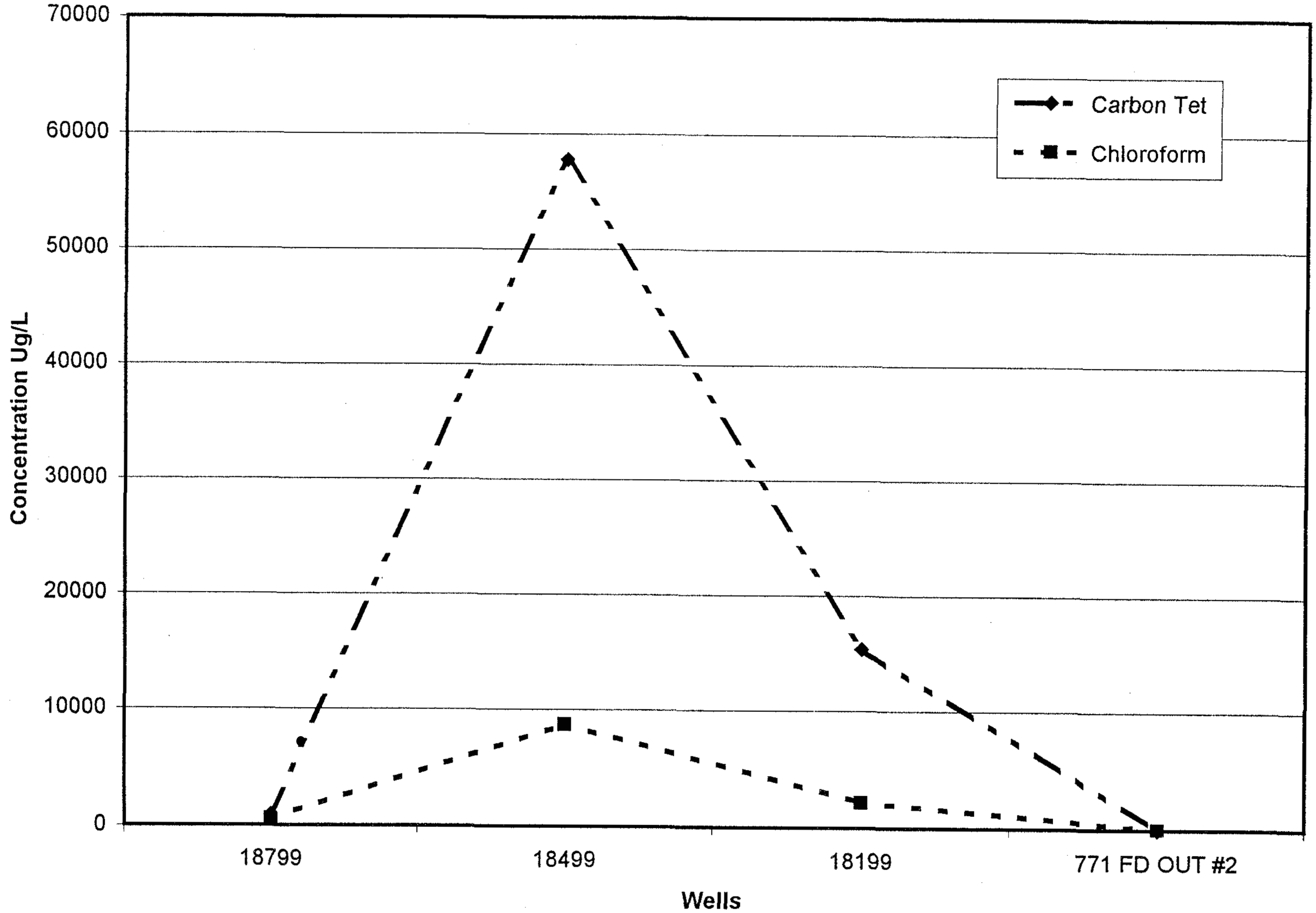

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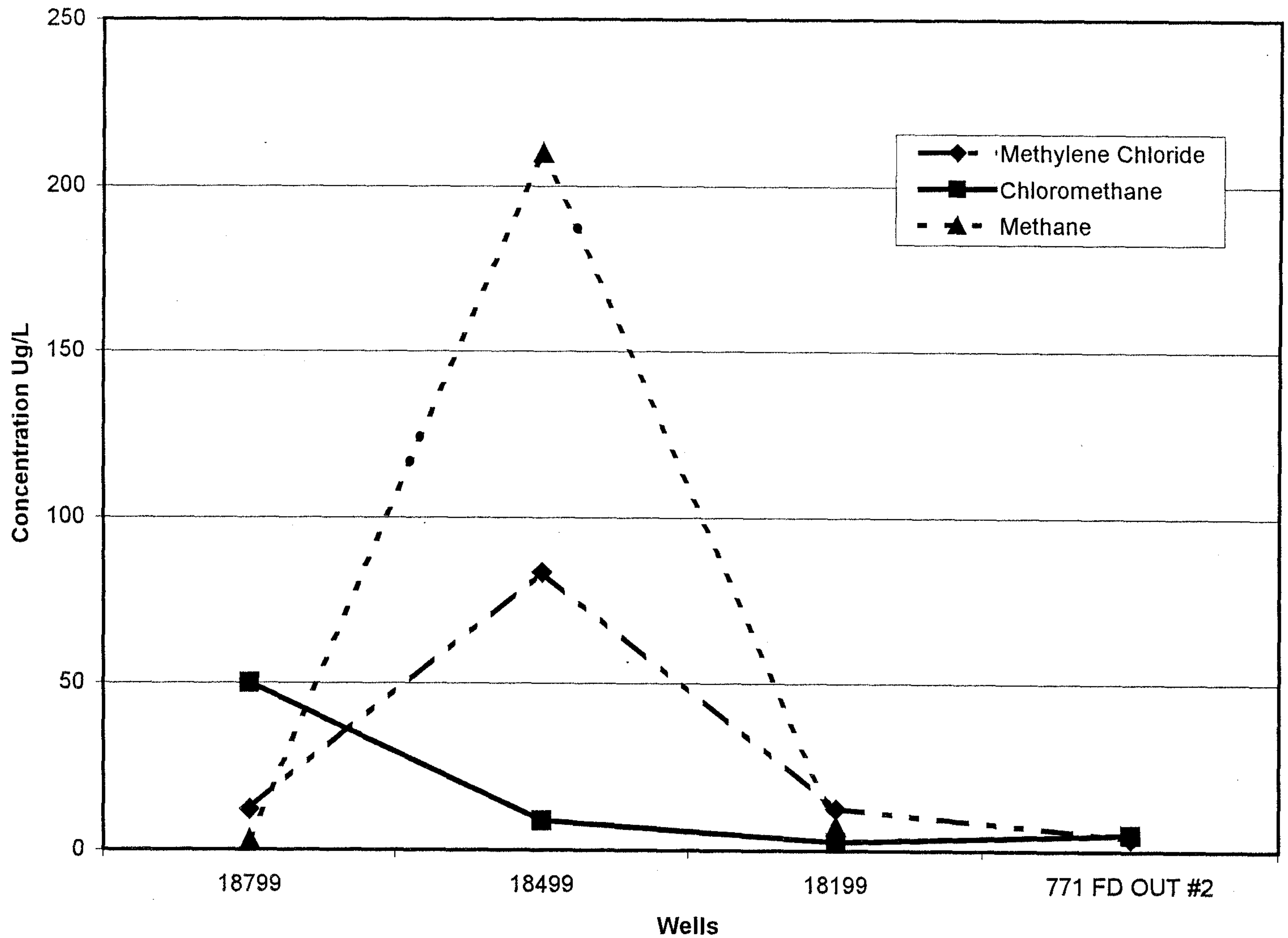
Figure 4-12
Methylene Chloride, Chloromethane and Methane Concentrations at IHSS 118.1



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4.3.3.2 Dissolved Oxygen

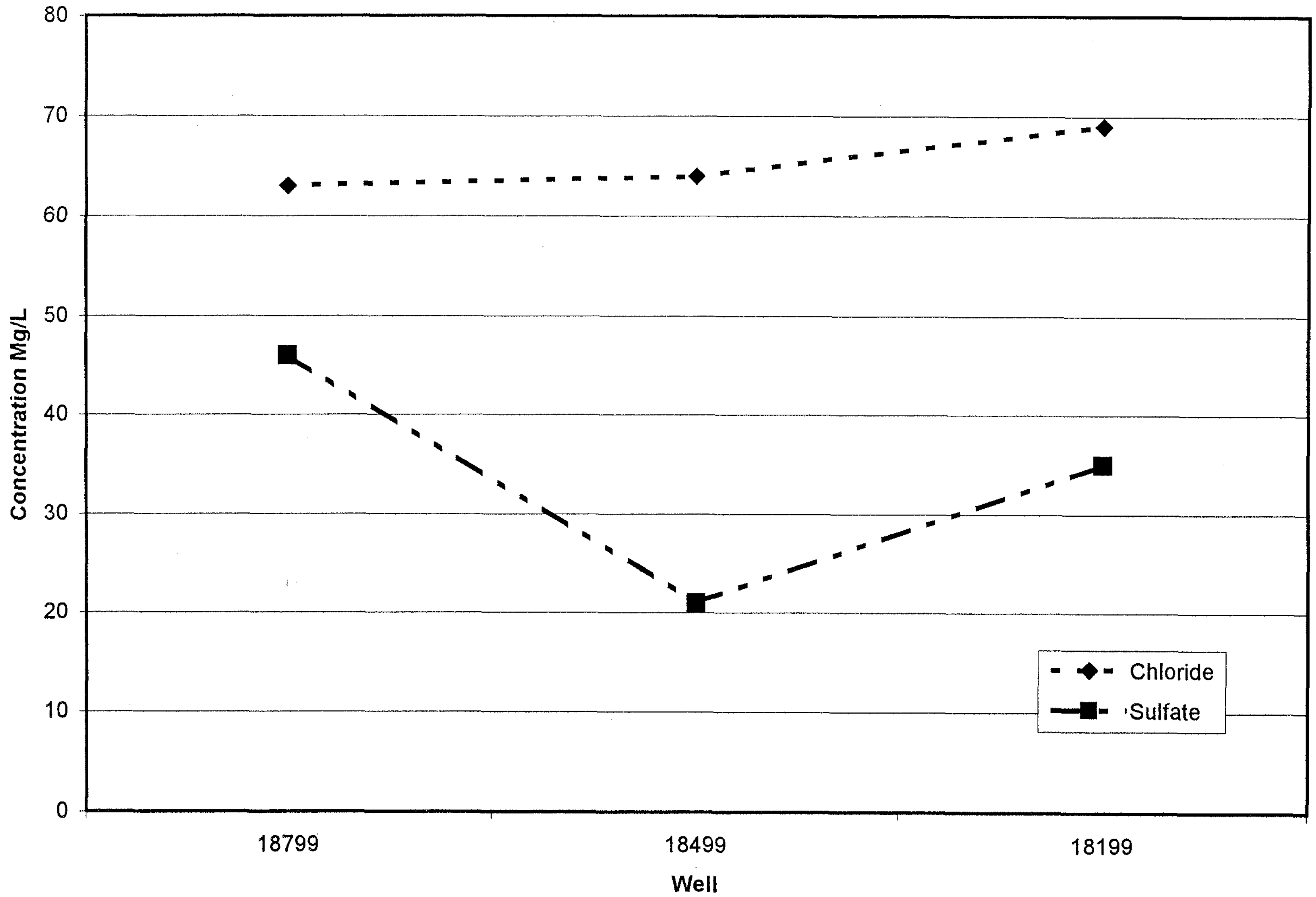
Dissolved oxygen is the favored electron acceptor used by bacteria for the biodegradation process. Anaerobic bacteria cannot function at DO concentrations above .5 mg/L and hence, reductive dechlorination cannot occur (Wiedemeier, et al, 1999). Figure 4-10 shows that upgradient DO concentration at well 18799 is at 5.4 mg/L and decreases to .06 mg/L in source well 18499. DO concentration rises again in downgradient well 18199. Taking the data at face value, it would appear that DO levels are detrimental for anaerobic degradation of organic compounds except at the source. DO was measured using a DO probe inside a flow-through cell at the well head. It could be that this method, though far superior to those obtained from bailed water, may allow for some oxygenation of the groundwater. Because DO is one of the most crucial measurements for determining the effects of biodegradation, downhole probes have been acquired to ensure that a representative measurement is obtained in future sample events.

4.3.3.3 Nitrate and Sulfate

Nitrate and sulfate were sampled because they, along with dissolved oxygen, can compete with chlorinated solvents as electron acceptors. If high levels of nitrate and/or sulfate were to exist in the groundwater in the vicinity of IHSS 118.1, the amount of reductive dechlorination of carbon tet and its by products could be retarded. The graph on Figure 4-10 shows the values for nitrate along the three well cross section at IHSS 118.1. The nitrate concentration in upgradient well 18799 is 2 mg/L which is near the RFETS background mean of 1.4 mg/L for Rocky Flats Alluvium (DOE, 1993b). In Figure 4-10, nitrate concentration is seen to decrease at the source and then increase again in concentration away from the source. This trend would be expected if biodegradation was occurring in the source area. Wiedemeier et al, 1996 have a scoring system for determining the potential for biodegradation. They suggest that a concentration of nitrate above 1 mg/L may impact biodegradation of chlorinated organics. Given the low concentration of nitrate in the vicinity of the IHSS (.05 mg/L at source well 18499), it would seem that nitrate is being removed from the process locally, but that nitrate concentration is perhaps impacting the biodegradation process away from the source. Because nitrate is a key indicator of the efficacy of biodegradation on chlorinated solvents, continued sampling is advised.

The sulfate concentration in upgradient well 18799 is 46 mg/L, which is above the RFETS background mean of 22 mg/L (DOE, 1993b). Figure 4-13 shows the concentration of sulfate dropping near source well 18499, and then increasing in downgradient wells. This trend would be expected if biodegradation

Figure 4-13
Chloride and Sulfate Concentrations at IHSS 118.1



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was occurring in the source area. Wiedemeier et al (1996) suggest that sulfate above 20 mg/L could compete with the chlorinated solvents as an electron acceptor and thus retard the biodegradation process of the latter. Given that sulfate was found at 22 mg/L in the source area and at higher levels away from the source, it can be deduced that sulfate may be retarding the amount of biodegradation of carbon tet occurring at IHSS 118.1. Because sulfate is a key indicator of the efficacy of biodegradation on chlorinated solvents, continued sampling is advised.

4.3.4 Metabolic By-Products

The measurement of the metabolic by-products of biodegradation are valuable to determine the predominant microbial and chemical processes that are occurring at IHSS 118.1. The following samples were taken to help determine whether actual biodegradation is occurring.

4.3.4.1 Ferrous Iron

Ferric iron (Fe III) is reduced to ferrous iron (FeII) during anaerobic biodegradation of organic hydrocarbons. Therefore an increase in ferrous iron concentration in the source area can suggest the amount of biodegradation that is occurring. Figure 4-10 shows that ferrous iron increases from 0.01 mg/L in background well 18799 to 1.6 mg/L in source well 18499, then decreases to 0.10 mg/L in downgradient well 18199. Wiedemeier et al (1996) believe that ferrous iron above 1 mg/L would allow reductive dechlorination to take place. Therefore it appears that some reductive dechlorination is occurring at the source. Because ferrous iron is a key indicator of the efficacy of biodegradation on chlorinated solvents, continued sampling is advised.

4.3.4.2 Sulfide

The production of hydrogen sulfide occurs during sulfate reduction and verifies that sulfate is acting as an electron acceptor during biodegradation. Figure 4-10 shows that sulfide is 0.02 mg/L in background well 18799 and does not change in concentration in the source and downgradient wells. Wiedemeier et al (1996) believe that sulfide above 1 mg/L would allow reductive dechlorination to take place. These results suggest that though sulfate is decreasing in concentration in the source area, the amount of hydrogen sulfide generated is minimal. Because of the conflicting evidence for biodegradation given by sulfate/sulfide analyses, and because sulfide is a key indicator of the efficacy of biodegradation on chlorinated solvents, continued sampling is advised.

4.3.4.3 Methane

The presence of methane in groundwater is indicative of strongly reducing conditions. Methane is produced through the biodegradation of petroleum hydrocarbons, and where present in groundwater containing chlorinated solvents, suggests that the chemistry of the groundwater is favorable for reductive dechlorination. Figure 4-12 shows that methane increases from 0.003 mg/L to 0.20 mg/L in the source area, then decreasing to 0.007 in downgradient well 18199. Wiedemeier et al (1996) believe that methane above 0.1 mg/L would allow reductive dechlorination to take place. Methane values are fairly low suggesting that there is little if any petroleum hydrocarbons present at IHSS 118.1. However, the increase in methane production in the source relative to background suggests that some reductive dechlorination is occurring. Because methane is a key indicator of the efficacy of biodegradation on chlorinated solvents, continued sampling is advised.

4.3.4.4 Chloride

The presence of elevated concentrations of chloride in groundwater relative to background suggests that biodegradation of organic solvents is taking place. This is because the replacement of hydrogen for chlorine in the chemical structure of the chlorinated organic compound during reductive dechlorination releases chlorine in the process. Figure 4-12 shows the concentrations of chloride seen in the vicinity of IHSS 118.1. Chloride concentration is in the 65 mg/L range and does not change appreciably in the three wells plotted, although side gradient well 18699 does show twice the concentration of chloride relative to the other wells. The RFETS background mean concentrations for chloride in alluvial materials is 8 to 18 mg/L (DOE, 1993b). The Groundwater Geochemistry Report for RFETS (EG&G, 1995c) shows that chloride concentration increases from west to east at RFETS and that chloride concentrations in the Industrial Area range from 25 to 100 mg/L. Given the lack of dramatic change in chloride concentration at IHSS 118.1 relative to both upgradient and downgradient wells and the surrounding Industrial Area, it may be that only limited reductive dechlorination is occurring at the IHSS. Because chloride is a key indicator of the efficacy of biodegradation on chlorinated solvents, and given the equivocal nature of results, continued sampling is advised.

4.3.5 Conclusions and Recommendations

Based on the preliminary results, a number of conclusions can be made. There is evidence of biodegradation at the IHSS 118.1 source. If the assumption is made that the breakdown products found at IHSS 118.1 are not part of the original free product composition, then based on the scoring system discussed in Wiedemeier et al (1996), the source area rates a score of 18 (see Table 4-5). The upgradient and downgradient wells rate a score of 3, which suggests that the environment of the aquifer away from the source may be hostile to biodegradation. These scores are derived using data from the three wells used for the cross section discussed above. Given the downgradient score with respect to biodegradation, the decrease in composition of organic solvents away from the source must be partly attributed to physical processes such as dilution and dispersion rather than strictly to biodegradation. These preliminary results suggest that a significant reduction in carbon tet is occurring at the source. Additional monitoring will help determine the rate at which biodegradation is occurring.

One of the footing drain outfalls shows low levels of carbon tet and chloroform that is probably attributable to inflow of carbon tet plume groundwater into the footing drain system. Given the low concentration of VOCs in outfall sample 771-FDOUT2, and the very low flow from the outfall, there does not appear to be a major contribution of VOCs to surface water.

The results of the follow-on sampling at IHSS 118.1 will be used to validate these preliminary findings and can also be used to assess possible remedial strategies. The Groundwater program will be evaluating the downgradient extent of VOC plumes in the Industrial Area in the future to determine potential impacts to surface water. This information will be incorporated with data from IHSS 118.1 and other projects to provide an integrated approach to groundwater management for the Site.

4.3.5.1 Sampling Recommendations

Based on the results obtained to date the following recommendations can be made with respect to future sampling:

1. The present sampling suite should be maintained for the second round of sampling, to confirm the results obtained in the first sampling event. After that point, it may be prudent to eliminate the semivolatile organic suite and TOC sample. The semivolatile organic suite was collected to determine whether there is evidence of fuel hydrocarbons that would aid in the breakdown of carbon tet. If these compounds are not encountered in the second sampling round, the analyses can be discontinued. TOC can be eliminated because only DOC is used in the scoring system for determining the degree of biodegradation.
2. Efforts will be increased to assure the collection of representative DO measurements because it is a critical parameter for determining whether biodegradation can succeed. Down-hole parameter probes will be used for collecting DO in the next sample round.
3. The two Building 771 outfall locations should also be sampled again to confirm the initial results obtained in the first round of sampling. In addition, a check will be made to see if the outfall with detectable concentrations of VOCs is active or has been abandoned.

5.0 BUILDING D&D

The DOE decontamination and decommissioning (D&D) process is the sequence of events that occurs in the disposition of surplus DOE facilities. D&D is primarily concerned with decontamination, dismantling, removal, or entombment of the surplus facilities. The primary tasks associated with D&D are:

- Surveillance and Maintenance
- Assessment and Characterization
- Environmental Review
- Close Out

Activities associated with these tasks involve the removal of fixed materials (including residual constituents of concern), equipment, piping, tanks, ducts, ceilings and other internal building structures, and the buildings themselves. In general, it is planned that D&D will be done in phases, allowing alternative interim use of most buildings before the final decommissioning of the buildings (DOE 1994b).

Building specific D&D activities involve three major steps:

- Deactivation of Building Processes
- Demolition of Building Structures
- Remediation of Building Foundations and Surroundings

The IM/IRA for the IA outlines monitoring activities established to ensure that building D&D activities do not inadvertently impact surface water by degrading groundwater beneath or in contact with the base of the demolished buildings. The proposed groundwater monitoring will provide the data necessary to determine if the precautions and actions taken during D&D have prevented or allowed migration of contaminants to groundwater. If existing information regarding a proposed D&D activity indicates the potential to contaminate groundwater, generally through a knowledge of historical building activity and use, then a pre-D&D groundwater baseline will be established for that building. Exceedances are defined as concentrations detected greater than the mean + 2 standard deviations above the baseline (K-H 1998b). Monitoring will be accomplished by the installation of D&D monitoring wells immediately adjacent to the specific building. These wells in conjunction with appropriately located existing wells will provide the baseline data, and also be utilized for future D&D monitoring of the building specific impacts, if any, on downgradient groundwater quality.

This is a new section to the Annual RFCA Groundwater Monitoring Report. It will be expanded during each successive year to include the D&D activities, as they pertain to groundwater, for that calendar year. The following subsections discuss D&D activities during 1998 for Building 123; Buildings 444, 771, and 886; and Building 779.

5.1 Building 123

Building 123, used as a laboratory for bioassay, dosimetry, and water quality parameter analyses, was located on Central Avenue between Third and Fourth Streets at RFETS. The building underwent D&D activities, and was ultimately demolished in 1998. Subsequent to demolition, six monitoring wells (10098-10598) were installed with a Geoprobe rig immediately adjacent to the building foundation. The purpose of these wells was twofold. First, to assess the potential impact of D&D activities on local groundwater quality and, second, to prepare an IHSS ranking for prioritizing the Building 123 site on the ER ranking list. This report is only concerned with the potential impact of Building 123 D&D activities on downgradient groundwater quality. Figure 5-1 presents the location of Building 123 and associated D&D monitoring wells.

It has been determined, based on the IMP, that four sampling events are required to collect a data set to be used for determination of a unique baseline for each building which will undergo D&D groundwater monitoring. Unfortunately, the schedule for Building 123 D&D became accelerated and it was not possible to collect the required amount of pre-demolition data to derive baseline values for the site. In addition, there are not an appropriate number or distribution of existing monitoring wells in the vicinity of Building 123 to sample for collection of baseline data (utilizing the previous three years sampling data) as the IM/IRA suggests. Only one sampling round, post demolition, was accomplished at the Building 123 D&D monitoring wells during 1998. Depending on groundwater flow conditions at a specific building, it may be possible to create a baseline even though the building has previously been demolished. If linear flow velocities in the immediate vicinity of the building are relatively low, then contaminants potentially mobilized by D&D may take a year or two to reach the D&D monitoring wells.

The results of the one sampling round completed at Building 123 during 1998 indicate that metals analyses exhibited no results above Tier II action levels. There were no Tier I exceedances for VOCs and radionuclide species. A few slight Tier II exceedances occurred for both VOCs and radionuclides. The Tier II exceedances are listed below. Future interpretations will compare upgradient to downgradient water quality instead of Tier levels.

VOCs:

- Monitoring well 10498, sampled on 8/12/98, PCE result of 15 µg/L

Radionuclides:

- Monitoring well 10098, sampled on 8/10/98, uranium 233/234 result of 1.13 pCi/L and uranium 238 result of 1.08 pCi/L
- Monitoring well 10298, sampled on 8/11/98, uranium 233/234 result of 1.08 pCi/L and uranium 238 result of 1.10 pCi/L
- Monitoring well 10498, sampled on 8/12/98, uranium 233/234 result of 1.41 pCi/L and uranium 238 result of 1.22 pCi/L

During 1999, it is anticipated that enough additional analytical data will be available to construct a groundwater chemistry baseline for Building 123.

5.2 Buildings 444, 771, and 886

The Sampling and Analysis Plan for the D&D monitoring of Buildings 444, 771, and 886 was initiated during late 1998. It is anticipated that the SAP will be completed and approved by the State by July 1999, and that the D&D monitoring wells associated with each building will be installed before the end of 1999. Building 444 is currently scheduled for demolition in 2002. Building 771, including Buildings 771C and 774, is currently scheduled for demolition in 2003. Building 886 is currently scheduled for demolition in 2000. This will allow adequate time to construct a groundwater chemistry baseline for each building. The 1999 Annual RFCA Groundwater Monitoring Report will include location maps for these buildings with the final locations of the D&D monitoring wells associated with each site.

5.3 Building 779

Building 779, placed into service in 1979, housed minor production and plutonium recovery operations, but was primarily a research and development facility. Some metal parts were assembled in this building and bulk plutonium residues were recovered in the hydride operations (DOE 1992a). The building is located in the PA approximately 200 feet south of the westernmost Solar Pond and is currently scheduled for demolition in 2000. Three monitoring wells, 02297, 02397, and 02497 were installed with a Geoprobe rig in 1997 to facilitate collection of a D&D monitoring baseline at Building 779. Figure 5-2 presents the building location and the associated D&D monitoring wells.

It has been determined, based on the IMP, that four sampling events are required to collect a data set to be used for determination of a unique baseline for each building which will undergo D&D groundwater monitoring. There will be adequate time for collecting the appropriate amount of data and determining the groundwater chemical baseline before the 2004 demolition date. No sampling rounds were completed during 1997 at the Building 779 D&D monitoring wells. Sampling rounds were accomplished with varying success at the Building 779 D&D monitoring wells during 1998. Not all monitoring wells produced the same number of sampling rounds or amount of samples per round because the wells were either dry or did not produce enough groundwater for full sample suites. Monitoring well 02297 produced enough groundwater in June for VOC analyses only. Monitoring well 02397 produced enough water in March for VOCs only, and in November for VOCs, metals and nitrates. Monitoring well 02497 produced enough water in March and June for VOCs and nitrates only; in November for VOCs only.

The results of these 1998 samples indicated that there were no concentrations from any Building 779 D&D monitoring well above Tier I action levels. Wells 02297 and 02497 had no results above Tier II action levels. The only result during 1998 above Tier II action levels was at monitoring well 02397, in November, where nitrates analysis resulted in a concentration of 12 mg/L.

6.0 GROUNDWATER CHARACTERIZATION ACTIVITIES

The following groundwater characterization activities were ongoing or were performed completely during calendar year 1998. The projects were performed jointly between the Groundwater Operations group and other ER groups at RFETS and are discussed here because of their pertinence to groundwater issues. The following sections are condensed discussions of the various groundwater characterization activities performed during 1998. Greater detail regarding each investigation may be obtained by reviewing the referenced reports for each area, which are listed below and in Section 9.0, References.

6.1 Mound Plume/SW059

The Mound Site consists of a former waste burial area where 1,405 drums containing uranium and beryllium contaminated lathe coolant (a mixture of approximately 70% hydraulic oil and 30% carbon tetrachloride), tetrachloroethene (PCE), other VOCs, and low levels of plutonium were stored. The drums, initially stored on the ground, were buried with soil between April 1954 and September 1958. Ten percent of the drums were suspected to have leaked. In 1970, all of the drums were exhumed from the Mound Site along with some radiologically contaminated soil. The Mound Site area has been disturbed often, generally by construction projects, since the initial source removal. Additional radioactive soils were identified during these projects and removed at later dates. Recent investigations have detected VOCs, primarily PCE, in subsurface soils at concentrations above the subsurface soil action levels that require cleanup.

From the Mound Site, the ground surface slopes steeply downward, to the north, towards the incised drainage of South Walnut Creek. The Mound Site groundwater plume is located north of Central Avenue and east of the PA fence. The plume, comprised primarily of VOC contamination, discharges as seeps and subsurface flow into the South Walnut Creek drainage in the vicinity of seep SW059. The VOC contamination is found along a line of monitoring wells downgradient (north) of the Mound Site and between the Mound Site and South Walnut Creek, indicating that the Mound Site is the primary source of the plume. Figure 6-1 presents the location of the Mound Site Plume area.

An accelerated soil removal action was completed during the spring of 1997 to remove VOC contaminated soils above the Tier I action levels from the Mound Site. Low temperature thermal desorption was used to remove VOCs and treated soils were returned to the excavation. As part of this project, a permanent culvert was installed in the previously unlined Central Avenue Ditch, located immediately upgradient of the source area, which contributed water to the Mound Site Plume.

A pre-remedial groundwater investigation was performed in March and April of 1997 to examine the nature and extent of the Mound Site Plume adjacent to South Walnut Creek. The results of the investigation indicate that the water level, and quantity of groundwater present, generally declines towards the east and west margins of the plume. The most commonly detected VOCs from the source area to the distal end of the plume are PCE and TCE. Other VOCs are present in the plume, mainly towards the distal end, as degradation products of PCE and TCE (DOE, 1997c). The goal of the investigation was to provide the necessary information to support the design of an interception/collection trench and the proper disposal of soil removed during construction of the interception/collection trench.

The Mound Site Plume project employs an innovative technology for the collection and treatment of groundwater contaminated with chlorinated organic compounds and low levels of radionuclides. Work performed during 1998 on this project consisted of the installation of the Mound Site Plume Treatment System (MSPTS). The MSPTS is a passive subsurface groundwater treatment system consisting of treatment cells containing zero valent iron; an impermeable barrier membrane constructed of high density polyethylene (HDPE) to capture and redirect contaminated groundwater; an engineered permeable filter media backfill, consisting of sand and pea gravel, and containing a 4-inch perforated HDPE pipe routed to a central collection sump; and a barrier monitoring system (piezometers). Some of the barrier monitoring system piezometers were installed during 1998; the remainder are scheduled for installation during 1999.

The system is designed to protect surface water by reducing mass loading consistent with RFCA action levels. The zero valent iron, contained in two buried treatment cells, is used to remediate VOC and radionuclide contaminated groundwater. After treatment, the water is discharged back to groundwater on the downgradient side of the treatment system through a French drain (RMRS, 1999e). During construction of the treatment system, a buried drain pipe was discovered that was probably contributing contaminated groundwater to the SW059 seep. The treatment system also collects this water.

Work scheduled for 1999 on this project consists of sampling and analysis of influent, treatment system effluent, and barrier monitoring wells, in order to ascertain the effectiveness of the MSPTS.

6.2 Solar Evaporation Ponds Nitrate/Uranium Plume

The RFCA set a milestone of fiscal year 1999 for the implementation of a remedial action which would control contaminated groundwater emanating from the Solar Evaporation Ponds, and prevent it from causing North Walnut Creek to have concentrations above its in-stream standards. The Solar Ponds Plume (SPP) is an area of groundwater contamination which extends from the SEPs, located in the northeastern portion of the PA, to the northeast towards North Walnut Creek and to the southeast towards South Walnut Creek. The primary analytes of concern are nitrate/nitrite and various uranium isotopes; however, other inorganic and organic compounds have also been identified at concentrations above the Tier II action levels.

The SPP emanates from the SEPs. VOCs have been detected in monitoring wells located in the western portion of the SEPs and south of the SEPs. The VOCs are thought to have originated from sources to the west and southeast of the SEPs. Several metal analytes have also been detected in SPP monitoring wells at concentrations above groundwater action levels. Figure 6-2 presents the site location.

The Interceptor Trench System (ITS) was constructed in 1971, and expanded in 1981, to dewater the hillside and prevent the SPP from advancing downgradient to North Walnut Creek. The ITS traverses the hillside to the north of the SEPs and collects surface water infiltration as well as alluvial groundwater; however, the ITS does not collect groundwater from the weathered bedrock immediately below the alluvium. Groundwater flowing through weathered bedrock may continue on towards North Walnut Creek. Water collected by the ITS since 1993 has been stored in modular storage tanks prior to treatment at Building 374.

As an initial phase in determining the appropriate remedial action for the SPP, RMRS began a study in 1997 to evaluate alternatives for the management and treatment of the water collected by the ITS. The objective of the study was to determine a permanent remedy for the SPP. Final evaluation of the alternatives required a detailed characterization of the water quality in the alluvium and weathered bedrock in the vicinity and downgradient of the SEPs (McLane Environmental, 1998). The 1998 field activites associated with this study continued to collect the data necessary to complete a SEPs conceptual hydrogeologic model and groundwater flow model, as well as evaluate the remaining feasible remedial alternatives. Groundwater characterization work completed on this project in 1998 included collection and analysis of groundwater samples from approximately ninety wells in the SEPs area including samples outside the SPP from the North and South Walnut Creek areas and upgradient (background) areas. The primary objective of the sampling was to determine the nature and extent of the SPP in the alluvium, weathered bedrock, and competent bedrock during the low flow (late fall/early winter) and high flow (spring) seasons.

The secondary objective was to evaluate the amount and distribution of uranium in the groundwater associated with the SPP, and estimate what portion of it is attributable to past RFETS activities. Initially, low flow samples (November 1997 through February 1998) from a combination of background, Walnut Creek drainage, and SPP wells were analyzed for uranium isotopes by alpha spectroscopy. Seven SPP wells were resampled during the high flow season (April 1998). In addition to analysis by alpha spectroscopy, four low flow samples and five high flow samples were subsequently sent to Las Alamos National Laboratory (LANL) for analysis of uranium isotopes by high resolution, inductively coupled plasma/mass spectroscopy (ICP/MS). The results of these analyses were used to calculate uranium isotope ratios, which can be used to differentiate between naturally occurring and anthropogenic uranium. As a first step in analyzing the source of uranium in the SPP groundwater, the alpha spectroscopy data was converted from isotope activity to isotope mass and the U-235 to U-238 ratios calculated. In naturally occurring uranium the U-235 to U-238 mass ratio is 0.0072. The resulting ratios were very inconsistent, and because the alpha spectroscopy data was determined not to have sufficient resolution for determining uranium isotopic ratios, the samples described above were sent to LANL for analysis by ICP/MS. The results of the ICP/MS analyses indicate that the uranium occurring in all background samples is naturally occurring. In addition, it was determined that groundwater containing anthropogenic uranium has not yet reached groundwater adjacent to North Walnut Creek (RMRS, 1999f). For additional information regarding these analyses reference the *Solar Ponds Plume Decision Document* (RF/RMRS-98-286.UN), (RMRS, 1999f).

In addition to groundwater sampling, four new monitoring wells were installed during 1998 to provide additional groundwater data where needed. One well, 03498, was installed to the north of the SEPs and three wells (03198, 03298, and 03398) were installed to the southeast of the SEPs (Plate 1). Monitoring well 03198 was dry, but the other three wells contained sufficient water for sampling and analyses.

Based on the results of the above described study, undertaken during 1997 and 1998, the *Solar Ponds Plume Decision Document* was prepared. The Decision Document outlines the remediation strategy, treatment goals, applicable regulatory requirements, and implementation schedule to accomplish a long-term and cost effective remedy for the groundwater collection, management, and treatment of the SPP. A reactive barrier, consisting of a funnel system which will direct SPP groundwater to a treatment cell containing zero-valence iron and a carbon source, was selected as the preferred remedial alternative. The other alternatives described in the Decision Document were found to be ineffective in treating the contaminants or did not achieve the long-term goals for the SPP and RFETS.

The SPP is currently being managed and treated according to the IM/IRA (DOE, 1992b; and 1994b). Activities scheduled for 1999 which are associated with the SPP include installation of the above described treatment system. Groundwater activities completed during 1999 will be described in the 1999 RFCA Groundwater Annual Report.

6.3 B-Ponds/East Trenches Plume

The East Trenches Groundwater Plume is located north of Central Avenue and east of the east perimeter road. This groundwater plume contains VOC contamination which is believed to originate from the East Trenches and 903 Pad sites and extends northward to where the plume discharges as seeps and subsurface flow into the South Walnut Creek drainage. Recent exceedances of the Tier II RFCA VOC groundwater action levels in a designated Tier II well near South Walnut Creek, and recent detections of VOCs in the B-ponds indicate that contaminated groundwater is reaching surface water at this location. Figure 6-3 presents the site location.

A large plume of contaminated groundwater is located in the East Trenches area. Most of the groundwater contamination is believed to be derived from the trenches on the north side of the East Access Road, which includes Trenches T-3 and T-4 (RMRS, 1996c). Upgradient monitoring wells indicate that a component of the contaminated groundwater in this area is derived from VOC contamination emanating from the 903 Pad. However, the VOC concentrations in groundwater increase by more than two orders of magnitude after the groundwater passes through Trenches T-3 and T-4, which reflects previous release from the trenches.

Trenches T-3 and T-4 were used between 1964 and 1967 for disposal of sanitary sewage sludge contaminated with low levels of uranium and plutonium, VOCs, crushed drums, and miscellaneous waste (DOE 1992b). In 1996 these trenches were excavated as part of an accelerated source removal action. Trench T-3, located approximately 300 feet north of the East Access Road and immediately west of Trench T-4, was approximately 134 feet long, 20 feet wide, and 10 feet deep. Trench T-4 was approximately 110 feet long, 15 feet wide, and 10 feet deep. The removed soil and debris were thermally treated to remove the VOCs, which consisted primarily of carbon tetrachloride, TCE, and PCE. The remediated soil, below Tier II action levels, was returned to the trench excavation and the area was revegetated. The component of the East Trenches plume derived from the VOC contamination at the 903 Pad and Lip areas is associated with drums containing plutonium and uranium contaminated soils and solvents which were stored in the area from the summer of 1958 to January 1967 (RMRS, 1996d; 1997).

Pre-remedial investigations were conducted in the fall of 1997 and the spring of 1998 to determine the extent and configuration of the distal end of the East Trenches plume near South Walnut Creek. Additional characterization work was conducted in the spring of 1998 to collect sufficient data to design a remedial action for the plume. A total of 32 Geoprobe boreholes were advanced with 25 temporary monitoring wells installed. These wells, where they contained sufficient water, were monitored for water table elevation and sampled for radioisotopes and VOCs. Soil samples were collected from several boreholes and analyzed for VOCs and other analytes.

Groundwater flow in the vicinity of the East Trenches plume is to the north and northeast and discharges primarily as seeps, springs, and baseflow to South Walnut Creek. This is particularly apparent where the water bearing strata are incised by the creek. There is a spring and seep complex on the south bank of South Walnut Creek, above ponds B-1 and B-2, where the Arapahoe No.1 Sandstone subcrops. Concentrations of VOCs above Tier I action levels were detected at this location during 1998. The presence of VOCs in the seep complex indicates that contaminants have reached South Walnut Creek. The Arapahoe No. 1 Sandstone is present beneath the East Trenches source area and constitutes a preferential groundwater flow pathway towards South Walnut Creek. This unit is continuous in the subsurface from the East Trenches to the distal end of the East Trenches plume and much of the groundwater flow and contaminant flux is through this material. In addition, contaminated groundwater from the East Trenches plume directly discharges into the Valley Fill Alluvium underlying South Walnut Creek. This deposit may also act as a preferential pathway for contaminated groundwater (RMRS, 1999g).

Work to be performed on this project during 1999 will be the installation of a downgradient capture system near South Walnut Creek to intercept contaminated groundwater. A subsurface groundwater collection system coupled with a passive reactive metal treatment system will be utilized to treat VOC contaminated groundwater from the East Trenches plume to below surface water action levels. The downgradient capture system was chosen as the best remediation method, following an evaluation including other more traditional options, because it effectively treats the existing VOCs to below action levels at lower life cycle cost than other treatment options.

An impermeable barrier groundwater collection system will be keyed into the underlying claystone or low permeability colluvium, depending on the elevation of the bedrock surface, and the collected groundwater will be treated in a separate treatment system. A collection sump will be installed at the eastern end of the collection system. The captured groundwater will then gravity flow out of the collection system into a series of cells containing reactive iron filings, which will remove the VOCs. The treated water is expected to discharge to groundwater through an infiltration gallery, however, for added flexibility the system will be designed to allow discharge directly to South Walnut Creek if necessary.

6.4 903 Pad/Ryan's Pit Plume

The 903 Pad/Ryan's Pit Plume is located directly south of the southeast corner of the PA and between the 903 Pad and Woman Creek at RFETS. Two sources, the 903 Pad and Ryan's Pit, contribute to this plume of contaminated groundwater. The primary analytes comprising the 903 Pad/Ryan's Pit Plume are carbon tetrachloride, TCE, and PCE. The nearest receiving streams for the plume are the South Interceptor Ditch (SID), located approximately 150 feet north of Woman Creek, and Woman Creek. There was an agreed upon 1999 compliance milestone for characterizing 903 Pad/Ryan's Pit Plume groundwater to protect surface water quality in Woman Creek. The Ryan's Pit source removal began in September, 1995, with the removal of contaminated soil. The soil was treated in February, 1996, and the project was completed in August, 1996, with the replacement of treated soil. The 903 Pad source removal is scheduled for 2001. Figure 6-4 presents the location of the 903 Pad/Ryan's Pit Plume area.

The 903 Pad was utilized as a drum storage area from the summer of 1958 to January 1967. The drums contained oils and VOCs contaminated with various radionuclides. Approximately 75 percent of the drums contained plutonium contaminated liquids and most of the remaining drums contained uranium contaminated liquids. Within the drums containing plutonium, the liquid was primarily lathe coolant and carbon tetrachloride in varying amounts. Also stored in drums were hydraulic, vacuum pump, and silicone oils; TCE; PCE; and acetone still bottoms. Leaking drums were observed in 1964 during routine handling operations. The area was fenced to restrict access, and the contents of leaking drums were transferred to new drums. When cleanup of the 903 Pad began in 1967, there were a total of 5,237 drums at the storage site, approximately 420 of which had leaked to some degree. An estimated 50 drums had leaked their entire contents. It was estimated that approximately 5,000 gallons of contaminated liquid, containing about 86 grams of plutonium, had escaped to the subsurface. During 1968 and 1969, some of the radiologically contaminated material was removed, the area regraded, and much of the area capped with asphalt. Dense non-aqueous phase liquids (DNAPLs) are suspected to exist beneath the 903 Pad and high concentrations of VOCs are present in groundwater beneath and downgradient of the site.

Ryan's Pit (previously known as Trench T-2) is located approximately 150 feet south of the 903 Pad and was approximately 20 feet long, 10 feet wide, and 5 feet deep. The 1995 source removal took place between September 5th and 12th. The excavation was 32 feet long, 18 feet wide, and varied in depth from 5.5 to 8 feet. It was originally thought that Ryan's Pit was used for disposal of sludge from the sanitary wastewater treatment plant, as the East Trenches, which were filled from 1954 through 1968. An extensive evaluation of aerial and low angle oblique photography, spanning the years of 1953 through 1971, indicated that Ryan's Pit was not in existence until 1969 (DOE 1996b). Ryan's Pit was used from approximately 1969 to 1971 for the disposal of nonradioactive liquid chemical wastes. The wastes were primarily solvents (PCE, TCE, and carbon tetrachloride), paint thinners, diesel fuel, and other construction related chemicals. However, wells downgradient of Ryan's Pit are anomalous in uranium 233/234 and U238 (DOE 1997 B, Plates 17 and 21). Radiation screening of the wastes was performed and if identified as nonradioactive, the liquids were dumped in the trench. Only liquids were put into the pit; containers were either reused or disposed of in other areas (DOE 1992b).

In 1998, the RFETS program to characterize the 903 Pad/Ryan's Pit plume was approved by the EPA and the CDPHE. A field investigation was performed during 1998 to delineate the extent of groundwater contamination in areas with potential impact to surface water at the distal end of the 903 Pad/Ryan's Pit plume. The investigation included the installation of 26 Geoprobe boreholes with six yielding enough water for VOC sample collection. The results were used to develop preliminary recommendations regarding the need for remedial action(s) to contain and/or treat contaminated groundwater from this plume. The results (Figure 6-4) indicate that the extent of the 903 Pad/Ryan's Pit plume adjacent to Woman Creek is limited, that VOC concentrations within the plume are relatively low, and the ability of the saturated colluvium and weathered claystone within the area of the groundwater plume to transmit significant amounts of groundwater (and therefore a significant flux of contaminants) to the Woman Creek drainage is limited. The contaminated groundwater plume is not affecting surface water quality, and there was evidence of the occurrence of natural attenuation (RMRS, 1999h). Based on the results, it was proposed that the preliminary remedial design consist of natural attenuation, which involves intrinsic biodegradation coupled with physical loss mechanisms, as a groundwater evaluation strategy for the 903 Pad/Ryan's Pit plume.

Work planned for 1999 on this project includes the installation of four permanent downgradient monitoring wells to monitor VOCs. One of these wells will twin 1998 Geoprobe borehole 01298. The other three will be downgradient of the 1998 Geoprobe boreholes and upgradient of the SID. These wells will provide the necessary information to establish a trend in downgradient VOC concentrations. Monitoring will initially be performed quarterly. If at any time the groundwater monitoring data indicates that the plume may cause surface water concentrations to exceed the established limits, then the remedial design for the 903 Pad/Ryan's Pit plume will have to be reevaluated.

6.5 903 Pad

As stated previously in Section 6.4, the 903 Pad was utilized as a drum storage area from the summer of 1958 to January 1967. The drums contained oils and VOCs contaminated with various radionuclides. Also stored in drums were hydraulic, vacuum pump, and silicone oils. Leaking drums were observed in 1964 during routine handling operations. When cleanup of the 903 Pad began in 1967, there were a total of 5,237 drums at the storage site, approximately 420 of which had leaked to some degree. It was estimated that approximately 5,000 gallons of contaminated liquid, containing about 86 grams of plutonium, had escaped to the subsurface. VOCs have impacted groundwater as a result of the leaking drums. DNAPLs are suspected to exist beneath the 903 Pad and high concentrations of VOCs are present in groundwater beneath and downgradient of the site. Figure 6-5 presents the site location.

A field investigation took place during 1998 (and continued into 1999) at the 903 Pad, 903 Lip Area, and Americium Zone, which are located in the Buffer Zone Operable Unit (OU). The purpose of the investigation was to estimate the volume of soil exceeding the RFCA Action Level Framework (ALF) Tier I soil action levels or other action levels identified as being protective of surface water for radionuclides in surface soils and VOCs in the subsurface (RMRS 1998d). This discussion will focus on the portion of the investigation associated with the 903 Pad and the VOC contamination associated with the 903 Pad. The portion of the investigation which encompasses the 903 Lip Area and the Americium Zone deal with radiological contamination which spread from the 903 Pad to the 903 Lip Area by wind and rain and to the Americium Zone primarily by wind dispersion. This airborne contamination has had little or no impact on groundwater.

Work completed during 1998 on the 903 Pad VOC investigation, that are pertinent to this discussion, consisted of the drilling and sampling of eight soil boreholes. The boreholes, which were advanced with a Geoprobe rig, varied in depth from 16 to 22 feet below ground surface and were sampled as composites. The results of these samples will be available in the RMRS 903 Pad Characterization Report to be released in 1999. No new monitoring wells were installed during the investigation of the 903 Pad.

Two existing monitoring wells, 06691 and 08891, both located on the 903 Pad, were sampled on June 10, 1998, in support of the 903 Pad VOC investigation. The results of these samples indicate that high concentrations of VOCs exist beneath the 903 Pad at both locations. Monitoring well 06691, located in the west central portion of the 903 Pad, had results of 85,000 and 9,400 µg/L for carbon tetrachloride and PCE, respectively. These concentrations are almost double for carbon tetrachloride and almost four times greater for PCE than from the previous sampling event, which took place on July 20, 1994. The concentration of TCE decreased from 2500 µg/L in 1994 to 180 µg/L during the 1998 sampling round. Methylene chloride had a 1998 result of 29,000 µg/L in monitoring well 06691. The 1998 data has not been validated yet, which may be pertinent in the case of methylene chloride, a common laboratory artifact. Methylene chloride contamination is known at well 06691, with validated concentrations as high as 24,000 µg/L observed in November 1992. Monitoring well 08891, located in the northeast quarter of the 903 Pad, was previously sampled on June 19, 1995. The concentration of carbon tetrachloride decreased from 5500 to 5300 µg/L from 1995 to 1998. The concentration of PCE increased from 16,000 to 27,000 µg/L from 1995 to 1998. Methylene chloride, which had historically been non-detect at monitoring well 08891, exhibited a result (not validated) of 11,000 µg/L in 1998. The concentration of TCE at monitoring well 08891decreased from 2,100 to 1,300 µg/L from 1995 to 1998.

Methylene chloride is a natural degradation product of carbon tetrachloride. The 903 Pad is situated such that groundwater flow tends to bifurcate from beneath the pad with a component of flow trending northeast and another component trending southeast. It is possible that the methylene chloride observed in 1998 at monitoring well 06691 is spreading northeast (and possibly impacting monitoring well 08891) and southeast.

During 1999, nine additional Geoprobe boreholes will be completed as part of the 903 Pad VOC investigation. Four new monitoring wells will be installed during 1999 on the 903 Pad which will twin existing wells that have Pu/Am detections. This work is associated with the Actinide Migration Project. The Site Characterization Report for the 903 Pad will be completed in 1999.

6.6 T-1 Trench Excavation

The T-1 trench is located approximately 40 feet south of the southeast corner of the PA fence at RFETS. The site is also known as IHSS 108. Before its excavation, the trench was anticipated to be approximately 200 feet long, 15 to 20 feet wide, and 10 feet deep. Figure 6-6 presents the location of the T-1 trench. Historical documentation indicates that depleted uranium metal chips, derived from lathe and machine turnings, and originating from Building 444 were packed in drums with lathe coolant and buried in the west end and possibly the east end of the T-1 trench. It was suspected that as many as 125 drums of this material were buried in the trench. In addition, it was suspected that ten drums of cemented cyanide and one drum of still bottoms, consisting of recovered waste solvents or evaporated lathe coolant sludge, were buried in the trench along with an unknown amount of assorted debris. Drums buried in the trench were covered with one to two feet of soil. The trench was filled intermittently from November 1954 to December 1962. Weed cutting activities in the fall of 1982 revealed two drums which were no longer adequately backfilled. Samples of the liquids and sludges in the drums yielded low levels of plutonium and uranium (potentially enriched). Since the discovery of the drums, numerous site investigations have been conducted along with historical aerial photograph review, a detailed record search, and employee interviews to evaluate the area and to determine the potential contaminants present, (RMRS, 1998e).

The geology of the area surrounding the T-1 trench consists of Rocky Flats Alluvium overlying weathered, predominantly claystone, bedrock of the Arapahoe Formation. In the trench area proper, one or two feet of fill material overlie anywhere from 8-13 feet of alluvium. The alluvium consists of lenses of poorly sorted clayey and silty sand and gravel interbedded with clay and silt lenses. Groundwater in the vicinity of the T-1 trench seasonally varies in depth from approximately 10 to 22 feet below ground surface. In May 1995, a period with abnormally high precipitation, groundwater was measured within six feet of the ground surface. It is likely that groundwater had, on occasion, reached the base of the trench and possibly come into contact with buried drums.

The T-1 trench excavation was completed from June 10 through August 20, 1998. The actual measurements of the excavation were not recorded. Prior to excavation a large, freestanding, temporary structure was constructed over the trench. This tent allowed for the excavation, inerting, and stockpiling of soil and waste regardless of weather conditions. One hundred seventy one drums or containers were removed from the trench during the excavation activities. Other than drum carcasses very little debris was encountered. Results of the sidewall and excavation floor verification samples indicate that all criteria in the *Final Proposed Action Memorandum for the Source Removal at Trench 1, IHSS 108* were met. For radionuclides and cyanide, subsurface soils were cleaned up to below Tier II action levels; for VOC's, subsurface soils were cleaned up to below Tier I action levels (RMRS, 1999i).

The T-1 trench may have possibly been a contributor to the contaminated groundwater that comprises the Mound Plume. As such, any groundwater contamination resulting from the leaching of the T-1 trench waste would be remediated by the now operating Mound Site Plume Treatment System (see Section 6.1).

Work to be performed on the project during 1999 will consist of removal of the T-1 trench tent structure in March and April, with final site reclamation to be completed by September 1999.

7.0 OTHER GROUNDWATER PROGRAM ACTIVITIES

7.1 Well Control Program

The Well Control Program (WCP) establishes the administrative guidelines for the installation of all new monitoring wells and piezometers at RFETS. The procedures which comprise the WCP will be implemented through the Water Operations Division; more specifically Groundwater Operations. The WCP was integrally designed to assure compliance with the procedures for monitoring well installations at RFETS and the complete documentation of all pertinent data relative to all monitoring wells installed at RFETS. It also assures compliance with the regulations set forth by the State of Colorado, Office of the State Engineer, State Board of Examiners of Water Well Construction and Pump Installation Contractors, in 2 CCR 402-2, *Revised and Amended Rules and Regulations of the Board of Examiners of Water Well Construction and Pump Installation Contractors.* The WCP also provides guidance to the organization or individual responsible for installation of the monitoring well(s) or piezometer(s) regarding the interface between the WCP and applicable RFETS soil disturbance procedures.

A Well Control Program was originally placed in effect by EG&G on June 1, 1995. After one year the original WCP expired and was not reinstated. The new WCP described in this section will be adopted in 1999. The new procedure document number is 1-K92-RFP-94-001, Revision 1.

The WCP has come back into existence because Groundwater Operations has been formally identified as the party ultimately responsible for well installation documentation. The purpose of the WCP program is threefold. First, to protect groundwater at RFETS from improper drilling and well installation procedures, and to ensure that each installation receives a unique well name. Second, to ensure that all permitting activities required by the State of Colorado are complied with. Third, to create a central repository for data collection and management with respect to all data generated from the installation and sampling of new monitoring wells and piezometers.

7.2 Real Time Groundwater Monitoring Network

As a requirement of the RFETS Integrated Monitoring Plan, a real time water level monitoring network was established for the UHSU during 1998. The network consists of twenty-five monitoring wells outfitted with In-Situ Inc., Model SP4000, Troll® data logging systems. The twenty-five monitoring locations were chosen for the program based on surface location, historical groundwater occurrence at each location, stratigraphic completion interval, and well construction details. The network provides for simultaneous measurement of groundwater levels at all locations. The goals of the real time groundwater monitoring network are to provide ample, concurrent, water level measurements for environmentally or hydrogeologically sensitive areas of RFETS, such as beneath and downgradient of the IA, and along stream channels to the north, south, and east of the IA. This data, when used alone or in conjunction with similarly collected surface water data, will allow a greater understanding of the effects of precipitation and surface water infiltration events on the UHSU.

The Troll is a compact downhole instrument that contains a data logger, temperature sensor, pressure transducer, and battery in a self-contained watertight unit. It measures and records temperature and temperature-corrected water level and allows for unattended long-term monitoring. It is programmed and downloaded with a portable computer. In-Situ Inc.'s Win-Situ® software allows the user to communicate with the Trolls in order to program a variety of short-term tests, a long-term monitoring scheme (such as is currently being implemented at RFETS), or to download data.

The real time groundwater monitoring network was activated with the initial twenty five monitoring stations on Wednesday, June 17, 1998. At this time all of the Trolls are programmed to measure the water level in each well every four hours; twelve A.M., four A.M., eight A.M., twelve P.M., four P.M., and eight P.M. As shown on Plate 11 and Figure 7-1, monitoring wells utilized for the real time groundwater monitoring network are located to provide sitewide coverage with concentration in the IA and immediately east of the IA. In addition, locations were chosen to monitor water levels in colluvial, alluvial, and weathered bedrock (pediment surface) deposits within the UHSU. The arrangement of Trolls throughout RFETS will allow observation, simultaneously across the site, of the impact of a precipitation infiltration event on the UHSU. The location of the Trolls within the various sedimentary depositional environments and weathered bedrock which comprise the UHSU will allow for a better understanding of the relationship between groundwater and surface water at various locations around RFETS.

The monitoring wells currently included in the real time groundwater monitoring network are 1086, 3686, 4786, 5586, 6886, 0187, 1487, P114889, P115489, P119389, P209889, P213689, P415889, P416589, B200589, B210489, 03791, 05191, 20691, 20991, 37591, 77492, 05293, 10794, and 51494.

There are certain wells where incomplete or very little data exists from the startup date of approximately June 17, 1998, through the end of calendar year 1998. Monitoring wells 20991 and 4786 had the Trolls initially installed under a water column of greater than 34.5 feet. This exceeded the 15 pounds per square inch (psi) rating of the Trolls. This was remedied by raising the Trolls in the wells so that the water column did not exceed the 15 psi rating. These are the only two wells in the real time groundwater monitoring system that could be affected by this phenomenon. In addition, there were a few monitoring wells for which data or partial data was inadvertently lost in the field because of operator error while learning to operate the Trolls, or upon downloading the Trolls. Because of these errors, there is no 1998 data for real time groundwater monitoring stations 4786, 51494, and 6886.

Data collected from the real time groundwater-monitoring network has been analyzed for the period of June 17 through December 31, 1998, for presentation in this 1998 Groundwater Monitoring RFCA Annual Report. Plate 11 presents the monitoring locations with a hydrograph of the groundwater level data collected from that station. Superimposed on the hydrograph is precipitation data from the particular surface water station at RFETS that is closest to the individual real time groundwater monitoring station. The hydrographs and precipitation data imply that responses to precipitation events are varied across RFETS. The following are general observations from the first one-half year of real time groundwater monitoring data:

Wells in or immediately adjacent to creek beds generally exhibit an almost immediate response to precipitation events. This includes wells B210489, 3686, and 6886. Well 10794, downstream of the A-Ponds, appears to be the exception. This well appears to only show responses to discharges from Pond A-4.

Wells east and southeast of the IA (1487, 05191, 03791, and 20991) generally exhibit baseflow conditions with little or no response to individual precipitation events. These wells show a relatively smooth decline in water level during the last six months of 1998. Well 20691, located just southeast of the southeast corner of the PA, exhibits this general trend but does have precipitation events superimposed on the baseflow in a subtle manner. This well is screened in a buried paleochannel and that may account for its sensitivity.

Wells in the IA (including the PA), of which there are 11 with Trolls, generally exhibit a response time to precipitation events of approximately a few days to up to ten days. One exception to this is well P114889, located just southeast of the southwest corner of the PA, which exhibits a general decline in baseflow with no precipitation events superimposed on it. It is situated between two wells with Trolls, P119389 and P115489, which exhibit a marked response to precipitation events. Another exception is well P209889, located on the hillside just north of the SEPs, which exhibits a baseflow decline with only very minor precipitation response.

Well 0187, located on the hillside just southwest of Building 881, shows the greatest and most immediate response of any well, other than those in drainages, to a precipitation event.

Well 1086, located immediately upgradient of the Present Landfill, exhibits an approximately one-week response time to precipitation events superimposed on baseflow.

The series of wells trending from the southwest to the northeast in the buffer zone north of the IA is expected to exhibit natural flow conditions along the high pediment surface without the effects of the plant site. These wells include 4786 and B200589, as well as 11494, 1190, and B200889 which will be added to the network during 1999. Wells 51494 and 5586 probably exhibit the same sort of background baseflow to which plant site wells can be compared. This may allow for a better understanding of the plant site's affect on an individual well's response to recharge or dewatering events.

The 1999 Annual RFCA Groundwater Monitoring Report will present one and a half years of groundwater and precipitation data on the hydrographs. More than a full yearly cycle will be displayed allowing for more complete analysis and discussion.

The following monitoring wells are scheduled to have Trolls installed in them and be added to the real time groundwater monitoring network during 1999: 0186, 3986, 1587, 4287, P414189, B200889, 1190, and 11494 (Figure 7-1). In addition, during 1999 all real time groundwater-monitoring stations will be brought into compliance for year 2000.

7.3 Well Abandonment and Installation

Figure 7-2 presents the locations of all 1998 monitoring well installations and abandonments.

During 1998 there were 67 monitoring wells installed at RFETS. Of the 67 wells, 61 were installed for the purpose of plume characterization, and six were installed as part of Building 123 D&D activities. All of these monitoring wells were installed with a Geoprobe to monitor the UHSU. Following is a listing of 1998 monitoring well installations by area:

- Monitoring wells 00198 – 02298 were installed as part of the 903 Pad/Ryan's Pit Plume characterization project.
- Monitoring wells 02398 – 02898, 03598, 03698, and 03998 – 04298 were installed as part of the East Trenches/B-Ponds characterization project.
- Monitoring wells 03198 – 03498 were installed as part of the Solar Ponds Plume study.
- Monitoring wells 10098 – 10598 were installed to monitor Building 123 D&D activities.
- Monitoring wells 20098 – 22298 were installed to monitor the North Industrial Area Plume.

During 1998 there were 35 monitoring wells abandoned at RFETS. The wells were abandoned because they were located in areas where treatment systems were going to be constructed or site remediation was taking place. Following is a list of 1998 well abandonments by area:

- Monitoring wells 10297 – 11297, 11497, 11597, and 11797 were abandoned as part of the construction activities associated with the SW059/Mound Site Plume treatment system.
- Monitoring wells 22597 – 23997, 24197 – 24497, and 25097 were abandoned as part of the construction activities associated with the B-Ponds/East Trenches Plume treatment system.
- Monitoring well 2387 was abandoned because of its proximity to the T-1 Trench excavation.

8.0 CONCLUSIONS AND FUTURE ACTIVITIES

The groundwater program experienced a number of improvements during 1998 and set projects in motion which will be accomplished in 1999. The following conclusions can be made with respect to the groundwater program based on the detailed discussions found elsewhere in the report.

Data collection and data quality for groundwater samples collected in 1998 have improved in the areas of data validation and verification. Much of this information was readily available and could be included in the data quality assessment section. Though the validation and verification percentages are not at the required levels the results show that only a small percentage of the analytical data is rejected. In addition, procedural improvements have been made in 1999 that will help collect more samples from wells that have low recharge. This will be done by timing visits based on an approximate recharge rate rather than a set time period.

The implementation of the real time monitoring network will also improve the understanding of the nature of recharge at RFETS and will potentially shed light on discharge and flow rates.

With respect to groundwater reporting, changes have been made to this years Annual RFCA Groundwater Monitoring Report based on input from the regulatory community. This report tried to focus on data evaluation as opposed to data presentation. Individual wells have been discussed more completely and the results of groundwater evaluations have been expanded. The actual data used in the annual report will be provided in the RFCA Quarterly reports and not reproduced here. The RFCA Quarterly reports have stayed the same except for some changes in the format of the report.

The Building D&D monitoring program was expanded with the addition of the Building 123 monitoring network. D&D monitoring for Bldg. 444, 886 and 771 will be implemented in 1999.

The largest programmatic improvement for groundwater has been in the characterization and quantification of groundwater plume nature and extent. Evaluation of the East Trenches Plume resulted in a remedial strategy involving the construction of a passive VOC treatment system which will be installed in 1999. The Solar Ponds nitrate/uranium plume also received additional characterization and modeling of contaminant fluxes. This has also resulted in a remedial decision to construct a groundwater treatment system in 1999.

Characterization activities were also initiated for the Ryan's Pit/903 Pad Plume with installation of a line of temporary wells and estimation of plume flux to Woman Creek. A natural attenuation project will be implemented in 1999 to determine whether contaminants are naturally degrading prior to impacting surface water.

Groundwater evaluation of the northern end of the Industrial Area plume has revealed significant contamination that may be reaching surface water from both the IA plume, and the carbon tetrachloride plume, which has IHSS 118.1 as its source. A natural attenuation study was also implemented for the IHSS 118.1 source area. Future groundwater evaluations will involve establishment of the eastern extent of the IA plume and investigating natural attenuation at the PU&D Yard Plume.

Given the large amount of new data with respect to the nature and extent of groundwater contamination at RFETS, a review of the groundwater monitoring network will be done in FY00. It is anticipated that some minor changes will be made to the monitoring based on this evaluation. Specific areas of review would include the north IA, the Present Landfill, and the Ryan's Pit source area which have shown evidence of increased extent or concentrations of contaminants.

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TARGET SHEET

Plate 1:

IMP Monitoring Well Location Map

Map ID: FY99, RFCA

September 23, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-003446

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TARGET SHEET

Plate 2:

Potentiometric Surface of Unconsolidated Surficial Deposits, Second Quarter 1998

Map ID: 99-0350

September 28, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-003446

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TARGET SHEET

Plate 3:

Potentiometric Surface of Unconsolidated Surficial Deposits, Fourth Quarter 1998

Map ID: 99-0350

September 13, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-003446

205

TARGET SHEET

Plate 4:

Radionuclides in Groundwater RFCA Wells, 1998

Map ID: 99-0352

August 13, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-__D03446__

206

TARGET SHEET

Plate 5:

VOCs in Groundwater RFCA Wells, 1998

Map ID: 99-0352

September 1, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-003446

207

TARGET SHEET

Plate 6: Water Quality Parameters in Groundwater RFCA Wells, 1998

Map ID: 99-0331

September 2, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-003446

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TARGET SHEET

Plate 7:

Nitrate Concentration in Groundwater 1991-1998 (Avg.)

Map ID: RFCA-RPT

September 1, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-005446

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TARGET SHEET

Plate 8:

Water Level Change Map 1996 - 1998 Second Quarter Data

Map ID: 99-0381

September 1, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-003446

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TARGET SHEET

Plate 9:

Water Level Change Map 1996 - 1998 Fourth Quarter Data

Map ID: 99-0381

August 13, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-005446

211

TARGET SHEET

Plate 10:

VOCs Composite Plume Map

Map ID: FY99 RFCA RPT

November 9, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-003446

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TARGET SHEET

Plate 11:

Real-Time Groundwater Monitoring Location Hydrographs with Precipitation Data

Map ID: 98-0191

September 1, 1999

DOE/RFFO CERCLA Administrative Record: SW-A-003446

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Appendix A

1998 Water Level Data

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Location	Date	Water Level from TOC (ft.)	Water Level Elevation (ft.)	Dry or Technically Dry (W.L. below scrn)	Bottom Screen Elevation
00191	1/14/98	18.81	5951.63		5945.44
00191	4/6/98	9.35	5961.09		5945.44
00197	4/7/98	5.81	5921.69		5918.10
00197	5/13/98	6.10	5921.40		5918.10
00197	7/1/98	9.34	5918.16		5918.10
00197	10/6/98	8.78	5918.72		5918.10
00293	1/12/98	25.02	6027.42		6004.44
00293	2/3/98	25.21	6027.23		6004.44
00293	3/2/98	25.24	6027.20		6004.44
00293	4/10/98	24.09	6028.35		6004.44
00293	5/5/98	20.39	6032.05		6004.44
00293	6/1/98	19.49	6032.95		6004.44
00293	7/9/98	20.87	6031.57		6004.44
00293	8/3/98	21.66	6030.78		6004.44
00293	9/3/98	22.15	6030.29		6004.44
00293	10/5/98	22.83	6029.61		6004.44
00293	11/2/98	23.42	6029.02		6004.44
00293	12/7/98	24.34	6028.10		6004.44
00297	1/7/98	11.01	5963.91	X	5966.62
00297	2/5/98	10.98	5963.94	X	5966.62
00297	3/3/98	11.11	5963.81	X	5966.62
00297	4/8/98	10.06	5964.86	X	5966.62
00297	7/7/98	9.65	5965.27	X	5966.62
00297	10/7/98	9.49	5965.43	X	5966.62
00391	1/14/98	4.28	5918.12		5900.60
00391	4/6/98	1.98	5920.42		5900.60
00397	4/7/98	11.00	5927.03	X	5929.03
00397	5/8/98	11.41	5926.62	X	5929.03
00397	7/1/98			DRY	5929.03
00397	10/6/98			DRY	5929.03
00491	1/8/98	12.85	5892.12		5887.47
00491	4/9/98	9.78	5895.19		5887.47
00597	1/7/98	10.92	5973.61		5963.63
00597	4/7/98	5.35	5979.18		5963.63
00597	5/8/98	5.62	5978.91		5963.63
00597	7/1/98	9.97	5974.56		5963.63
00597	10/5/98	12.03	5972.50		5963.63
00697	1/13/98			DRY	5968.04
00697	4/9/98			DRY	5968.04
00697	7/1/98			DRY	5968.04
00697	10/6/98	11.66	5964.38	X	5968.04
00797	1/13/98	23.49	5917.51		5914.20
00797	2/9/98	22.00	5919.00		5914.20
00797	3/2/98	27.72	5913.28	X	5914.20

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00797	4/9/98	24.78	5916.22		5914.20
00797	7/2/98	18.70	5922.30		5914.20
00797	10/8/98	21.87	5919.13		5914.20
00891	1/8/98			DRY	5852.05
00891	2/9/98			DRY	5852.05
00891	3/3/98			DRY	5852.05
00891	4/9/98			DRY	5852.05
00891	5/5/98			DRY	5852.05
00891	6/5/98			DRY	5852.05
00891	7/1/98			DRY	5852.05
00891	8/4/98			DRY	5852.05
00897	4/8/98	16.78	5950.82		5939.10
00897	7/8/98	19.56	5948.04		5939.10
00897	10/5/98	21.87	5945.73		5939.10
00997	1/5/98	5.80	5796.10		5791.50
00997	2/5/98	5.82	5796.08		5791.50
00997	3/3/98	5.82	5796.08		5791.50
00997	4/13/98	5.19	5796.71		5791.50
00997	5/5/98	4.49	5797.41		5791.50
00997	6/2/98	4.87	5797.03		5791.50
00997	7/1/98	5.69	5796.21		5791.50
00997	8/4/98	11.02	5790.88	X	5791.50
00997	9/3/98	6.08	5795.82		5791.50
00997	10/6/98	5.97	5795.93		5791.50
00997	11/4/98	5.92	5795.98		5791.50
00997	12/3/98	5.88	5796.02		5791.50
01097	5/8/98	11.74	6017.26		5989.20
01197	1/16/98	13.24	6002.04		5987.28
01197	5/8/98	6.84	6008.44		5987.28
01291	1/8/98	17.08	5835.77	X	5839.55
01291	4/9/98	17.07	5835.78	X	5839.55
01291	10/6/98	13.70	5839.15	X	5839.55
01297	5/8/98	2.21	6013.89		5982.10
01391	1/7/98	10.72	5964.58		5961.30
01391	2/9/98	10.75	5964.55		5961.30
01391	3/5/98	11.08	5964.22		5961.30
01391	4/1/98	10.51	5964.79		5961.30
01391	5/6/98	9.81	5965.49		5961.30
01391	6/3/98	10.04	5965.26		5961.30
01391	7/1/98	10.39	5964.91		5961.30
01391	8/4/98	10.65	5964.65		5961.30
01391	9/8/98	11.03	5964.27		5961.30
01391	10/5/98	11.39	5963.91		5961.30
01391	11/5/98	11.62	5963.68		5961.30
01391	12/7/98	11.36	5963.94		5961.30
01397	5/8/98	1.31	6005.63		5984.74
01497	5/8/98	3.97	5999.93		5980.80
01597	5/8/98	4.50	6001.86		5976.76
01697	5/8/98	17.11	5981.85		5970.76

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01797	5/8/98	15.71	5981.29		5975.00
0186	1/5/98	9.45	5619.87		5619.12
0186	2/9/98	9.19	5620.13		5619.12
0186	3/3/98	8.99	5620.33		5619.12
0186	4/13/98	8.51	5620.81		5619.12
0186	5/4/98	8.95	5620.37		5619.12
0186	6/4/98	9.71	5619.61		5619.12
0186	7/2/98	10.71	5618.61	X	5619.12
0186	8/4/98	11.96	5617.36	X	5619.12
0186	9/1/98	12.31	5617.01	X	5619.12
0186	10/8/98			DRY	5619.12
0186	11/3/98			DRY	5619.12
0186	12/4/98	9.94	5619.38		5619.12
0187	1/6/98	9.79	5984.29		5982.28
0187	3/12/98	10.71	5983.37		5982.28
0187	4/8/98	6.91	5987.17		5982.28
0187	5/7/98	7.22	5986.86		5982.28
0187	6/3/98	8.56	5985.52		5982.28
0187	6/18/98	9.00	5985.08		5982.28
0187	7/8/98	9.68	5984.40		5982.28
01897	5/8/98	10.06	5980.44		5967.70
0190	1/12/98	36.00	6009.88		6001.38
0190	2/4/98	36.00	6009.88		6001.38
0190	3/4/98	36.64	6009.24		6001.38
0190	4/10/98	31.30	6014.58		6001.38
0190	5/5/98	25.13	6020.75		6001.38
0190	6/1/98	27.88	6018.00		6001.38
0190	7/9/98	32.25	6013.63		6001.38
0190	8/3/98	33.67	6012.21		6001.38
0190	9/3/98	34.64	6011.24		6001.38
0190	10/5/98	35.61	6010.27		6001.38
0190	11/2/98	36.22	6009.66		6001.38
0190	12/2/98	36.77	6009.11		6001.38
01997	5/8/98	7.66	5978.24		5973.90
02097	5/8/98	3.72	5972.03		5963.85
02197	4/7/98	5.34	5955.36		5949.80
02197	5/8/98	6.03	5954.67		5949.80
02197	7/1/98	10.81	5949.89		5949.80
02197	10/6/98	12.82	5947.88	X	5949.80
02297	1/12/98	12.20	5966.45	X	5966.65
02297	2/5/98	12.25	5966.40	X	5966.65
02297	3/3/98	12.37	5966.28	X	5966.65
02297	4/8/98	11.43	5967.22		5966.65
02297	7/7/98	12.22	5966.43	X	5966.65
02297	10/7/98	12.43	5966.22	X	5966.65
02397	1/12/98	10.53	5976.28		5975.81
02397	2/5/98	11.31	5975.50	X	5975.81
02397	3/3/98			DRY	5975.81
02397	4/8/98	9.06	5977.75		5975.81

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02397	7/7/98	11.46	5975.35	X	5975.81
02397	10/7/98	11.42	5975.39	X	5975.81
02497	1/12/98	8.71	5970.71		5968.42
02497	2/5/98	8.85	5970.57		5968.42
02497	3/3/98			DRY	5968.42
02497	4/8/98	5.94	5973.48		5968.42
02497	7/7/98	8.11	5971.31		5968.42
02497	10/7/98	9.31	5970.11		5968.42
02591	1/16/98	43.33	5882.01		5876.24
02591	5/11/98	39.24	5886.10		5876.24
02691	2/19/98	10.33	5926.05		5920.38
02691	3/11/98	10.15	5926.23		5920.38
02691	4/2/98	7.82	5928.56		5920.38
02691	5/6/98	6.71	5929.67		5920.38
02691	6/5/98	7.15	5929.23		5920.38
02697	1/6/98	24.57	5893.33		5891.80
02697	2/9/98	24.59	5893.31		5891.80
02697	3/4/98	24.68	5893.22		5891.80
02697	4/1/98	24.16	5893.74		5891.80
02697	5/7/98	21.72	5896.18		5891.80
02697	7/2/98	21.57	5896.33		5891.80
02697	10/12/98	22.70	5895.20		5891.80
02797	1/6/98	37.62	5893.90		5890.12
02797	2/9/98	37.67	5893.85		5890.12
02797	3/4/98	37.77	5893.75		5890.12
02797	4/1/98	37.81	5893.71		5890.12
02797	5/7/98	35.07	5896.45		5890.12
02797	7/6/98	34.01	5897.51		5890.12
02797	10/12/98	35.47	5896.05		5890.12
02897	1/6/98	36.57	5893.18		5892.95
02897	2/9/98	36.62	5893.13		5892.95
02897	3/4/98	36.73	5893.02		5892.95
02897	4/1/98	36.75	5893.00		5892.95
02897	5/7/98	34.49	5895.26		5892.95
02897	7/6/98	33.49	5896.26		5892.95
02897	10/12/98	34.81	5894.94		5892.95
0290	1/12/98	47.27	6003.38		5993.15
0290	2/4/98	47.22	6003.43		5993.15
0290	3/4/98	47.37	6003.28		5993.15
0290	4/10/98	46.79	6003.86		5993.15
0290	5/5/98	42.80	6007.85		5993.15
0290	6/1/98	41.78	6008.87		5993.15
0290	7/9/98	43.47	6007.18		5993.15
0290	8/3/98	44.34	6006.31		5993.15
0290	9/3/98	45.04	6005.61		5993.15
0290	10/5/98	45.67	6004.98		5993.15
0290	11/2/98	46.03	6004.62		5993.15
0290	12/2/98	46.43	6004.22		5993.15
03191	1/13/98	20.18	5931.84		5930.82

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03191	4/1/98	18.36	5933.66		5930.82
03191	5/11/98	16.10	5935.92		5930.82
03191	10/12/98	20.14	5931.88		5930.82
03198	3/3/98	4.50	5925.00		5917.50
03198	4/8/98	0.83	5928.67		5917.50
03198	5/6/98	1.96	5927.54		5917.50
03198	6/5/98	4.40	5925.10		5917.50
03298	3/3/98	18.31	5930.19		5923.50
03298	4/8/98	14.91	5933.59		5923.50
03298	5/6/98	15.38	5933.12		5923.50
03298	6/5/98	16.90	5931.60		5923.50
03398	3/5/98	11.90	5915.60		5908.50
03398	4/8/98	9.34	5918.16		5908.50
03398	5/7/98	10.16	5917.34		5908.50
03398	6/5/98	11.07	5916.43		5908.50
03498	3/4/98			DRY	5878.50
03498	4/9/98			DRY	5878.50
03498	5/7/98	14.75	5879.75		5878.50
03498	6/5/98	13.86	5880.64		5878.50
03591	5/11/98	18.18	5932.62		5920.70
03691	1/13/98	33.46	5900.97		5894.43
03691	5/11/98	34.75	5899.68		5894.43
03791	1/13/98	37.91	5900.33		5890.24
03791	3/11/98	38.47	5899.77		5890.24
03791	4/1/98	38.20	5900.04		5890.24
03791	5/5/98	34.33	5903.91		5890.24
03791	6/4/98	33.69	5904.55		5890.24
03791	6/17/98	34.26	5903.98		5890.24
03791	7/2/98	35.15	5903.09		5890.24
0386	1/5/98	17.11	5660.75		5654.16
0386	2/9/98	17.18	5660.68		5654.16
0386	3/3/98	17.18	5660.68		5654.16
0386	4/13/98	16.41	5661.45		5654.16
0386	5/4/98	15.49	5662.37		5654.16
0386	6/4/98	14.83	5663.03		5654.16
0386	7/2/98	14.85	5663.01		5654.16
0386	8/4/98	15.31	5662.55		5654.16
0386	9/2/98	15.46	5662.40		5654.16
0386	10/8/98	15.72	5662.14		5654.16
0386	11/3/98	15.38	5662.48		5654.16
0386	12/4/98	15.95	5661.91		5654.16
0390	1/8/98	55.98	6023.15		6014.13
0390	2/3/98	56.04	6023.09		6014.13
0390	3/2/98	55.98	6023.15		6014.13
0390	4/10/98	55.95	6023.18		6014.13
0390	5/5/98	54.33	6024.80		6014.13
0390	6/1/98	52.79	6026.34		6014.13
0390	7/8/98	52.50	6026.63		6014.13
0390	8/3/98	52.80	6026.33		6014.13

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0390	9/3/98	52.85	6026.28		6014.13
0390	10/5/98	53.18	6025.95		6014.13
0390	11/2/98	53.28	6025.85		6014.13
0390	12/7/98	53.93	6025.20		6014.13
03991	1/8/98	34.83	5902.04		5899.47
03991	4/1/98	35.50	5901.37		5899.47
03991	5/11/98	28.42	5908.45		5899.47
03991	7/2/98	30.63	5906.24		5899.47
03991	10/12/98	34.46	5902.41		5899.47
04091	1/8/98	37.40	5892.74	X	5894.14
04091	4/1/98	37.52	5892.62	X	5894.14
04091	5/11/98	36.42	5893.72	X	5894.14
04091	10/12/98	37.29	5892.85	X	5894.14
04191	1/14/98	17.89	5939.10	X	5939.89
04191	4/6/98	18.06	5938.93	X	5939.89
04591	1/14/98	44.78	5905.47	X	5906.15
04591	4/6/98	44.87	5905.38	X	5906.15
04591	7/6/98	42.90	5907.35		5906.15
0487	2/9/98	8.08	5903.50		5892.08
0487	3/2/98	8.55	5903.03		5892.08
0487	4/9/98	4.26	5907.32		5892.08
0487	5/5/98	4.40	5907.18		5892.08
0487	6/1/98	5.70	5905.88		5892.08
0487	7/2/98	7.50	5904.08		5892.08
0487	8/4/98	8.98	5902.60		5892.08
0487	9/8/98	10.19	5901.39		5892.08
0487	10/8/98	11.31	5900.27		5892.08
0487	11/3/98	11.78	5899.80		5892.08
0487	12/1/98	11.95	5899.63		5892.08
04991	1/15/98	41.31	5897.32	X	5898.33
04991	4/13/98	41.28	5897.35	X	5898.33
04991	7/2/98	36.09	5902.54		5898.33
04991	10/6/98	37.58	5901.05		5898.33
05091	1/15/98	42.99	5896.25		5895.24
05091	4/13/98	43.02	5896.22		5895.24
05091	7/2/98	37.88	5901.36		5895.24
05091	10/6/98	39.77	5899.47		5895.24
05093	2/10/98	9.84	5955.70		5955.04
05191	6/16/98	38.31	5901.54		5893.85
05191	7/6/98	38.59	5901.26		5893.85
05193	1/6/98	9.71	5960.87		5959.18
05193	2/5/98	8.93	5961.65		5959.18
05193	2/16/98	9.06	5961.52		5959.18
05193	3/3/98	9.23	5961.35		5959.18
05193	4/2/98	7.22	5963.36		5959.18
05193	5/6/98	7.11	5963.47		5959.18
05193	6/2/98	7.86	5962.72		5959.18
05193	7/7/98	9.99	5960.59		5959.18
05193	8/5/98	11.15	5959.43		5959.18

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05193	9/2/98	11.67	5958.91	X	5959.18
05193	10/7/98	12.34	5958.24	X	5959.18
05193	11/2/98	12.60	5957.98	X	5959.18
05193	12/1/98	12.60	5957.98	X	5959.18
05197	1/27/98	7.46	5979.24		5958.70
05291	1/14/98	36.71	5906.29	X	5907.90
05291	4/6/98	36.80	5906.20	X	5907.90
05293	1/12/98	7.68	5975.43		5975.41
05293	2/5/98	7.85	5975.26	X	5975.41
05293	3/3/98	8.18	5974.93	X	5975.41
05293	4/8/98	6.60	5976.51		5975.41
05293	5/6/98	7.11	5976.00		5975.41
05293	6/2/98	8.15	5974.96	X	5975.41
05293	6/17/98	8.23	5974.88	X	5975.41
05293	7/7/98	9.16	5973.95	X	5975.41
05391	1/8/98	34.44	5907.23		5906.57
05391	4/1/98	34.30	5907.37		5906.57
05391	5/11/98	26.34	5915.33		5906.57
05391	7/2/98	31.06	5910.61		5906.57
05391	10/12/98	34.60	5907.07		5906.57
05393	2/11/98	18.91	5950.78		5947.59
05397	1/27/98	8.52	5979.13		5962.85
05497	1/27/98	6.54	5979.36		5963.50
05691	4/1/98	28.37	5920.62		5913.89
05691	5/11/98	13.02	5935.97		5913.89
05691	7/2/98	21.42	5927.57		5913.89
05691	10/12/98	28.12	5920.87		5913.89
05697	1/27/98	6.86	5978.94		5967.00
05897	1/27/98	6.77	5890.78		5875.25
05997	1/27/98	7.40	5979.30		5964.30
06091	1/6/98	36.94	5894.66		5890.90
06091	2/9/98	37.04	5894.56		5890.90
06091	3/4/98	37.18	5894.42		5890.90
06091	4/1/98	37.16	5894.44		5890.90
06091	5/5/98	34.27	5897.33		5890.90
06091	6/4/98	32.61	5898.99		5890.90
06091	7/2/98	32.61	5898.99		5890.90
06091	8/4/98	33.24	5898.36		5890.90
06091	9/1/98	33.63	5897.97		5890.90
06091	10/12/98	34.46	5897.14		5890.90
06091	11/4/98	34.90	5896.70		5890.90
06091	12/7/98	35.52	5896.08		5890.90
06191	1/6/98	33.58	5887.14	X	5888.62
06191	4/1/98	33.85	5886.87	X	5888.62
06191	10/12/98	31.86	5888.86		5888.62
06291	1/6/98	27.66	5871.62		5866.38
06291	2/9/98	26.96	5872.32		5866.38
06291	3/4/98	26.77	5872.51		5866.38
06291	4/1/98	26.85	5872.43		5866.38

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06291	5/4/98	26.02	5873.26		5866.38
06291	6/4/98	25.25	5874.03		5866.38
06291	8/4/98	24.14	5875.14		5866.38
06291	9/1/98	24.07	5875.21		5866.38
06291	10/12/98	24.27	5875.01		5866.38
06291	11/4/98	24.34	5874.94		5866.38
06291	12/7/98	24.41	5874.87		5866.38
06391	1/6/98			DRY	5882.57
06491	1/15/98	14.40	5658.85		5657.35
06491	4/13/98	16.76	5656.49	X	5657.35
06491	7/2/98	11.05	5662.20		5657.35
06491	10/8/98	12.53	5660.72		5657.35
06991	1/14/98	18.48	5956.09		5945.57
06991	4/6/98	9.85	5964.72		5945.57
07291	1/14/98	20.68	5958.12	X	5958.20
07291	2/2/98	20.86	5957.94	X	5958.20
07291	3/2/98	21.01	5957.79	X	5958.20
07291	4/6/98	17.12	5961.68		5958.20
07291	5/6/98	15.28	5963.52		5958.20
07291	6/8/98	18.31	5960.49		5958.20
07291	7/6/98	20.16	5958.64		5958.20
07291	8/10/98	20.62	5958.18	X	5958.20
07291	9/8/98	20.79	5958.01	X	5958.20
07291	11/4/98	21.10	5957.70	X	5958.20
07291	12/4/98	21.17	5957.63	X	5958.20
07391	1/8/98	7.65	5942.96		5939.21
07391	4/9/98	5.65	5944.96		5939.21
07391	7/6/98	7.96	5942.65		5939.21
07391	10/6/98	8.90	5941.71		5939.21
08091	1/14/98			DRY	5933.21
08091	4/6/98			DRY	5933.21
08091	7/6/98	15.67	5933.84		5933.21
0990	1/5/98	4.84	6078.64		6048.48
0990	2/4/98	5.16	6078.32		6048.48
0990	3/2/98	6.31	6077.17		6048.48
0990	4/1/98	3.04	6080.44		6048.48
0990	5/4/98	2.10	6081.38		6048.48
0990	6/1/98	2.93	6080.55		6048.48
0990	7/1/98	5.10	6078.38		6048.48
0990	8/3/98	5.64	6077.84		6048.48
0990	9/1/98	6.15	6077.33		6048.48
0990	10/6/98	6.71	6076.77		6048.48
0990	11/3/98	6.75	6076.73		6048.48
0990	12/1/98	6.98	6076.50		6048.48
10092	1/13/98			DRY	5881.67
10098	9/17/98	5.98	6029.52		6026.80
10098	10/5/98	6.34	6029.16		6026.80
10194	1/15/98	38.64	5901.74		5899.58
10194	4/9/98	38.51	5901.87		5899.58

10194	7/6/98	35.66	5904.72		5899.58
10198	9/17/98	4.57	6030.93		6022.40
10198	10/5/98	4.89	6030.61		6022.40
10292	1/13/98			DRY	5902.76
10294	1/5/98	4.09	5602.11		5591.60
10294	4/13/98	3.01	5603.19		5591.60
10294	7/2/98	3.62	5602.58		5591.60
10294	10/8/98	3.06	5603.14		5591.60
10298	9/17/98	4.71	6024.69		6013.80
10298	10/5/98	5.23	6024.17		6013.80
10392	1/13/98			DRY	5906.85
10394	1/5/98	4.72	5628.41		5624.93
10394	4/13/98	4.65	5628.48		5624.93
10394	7/2/98			DRY	5624.93
10394	10/8/98			DRY	5624.93
10398	9/17/98	5.35	6025.15		6019.40
10398	10/5/98	5.66	6024.84		6019.40
10492	1/13/98	30.37	5902.44		5902.51
10498	9/17/98	5.62	6026.88		6020.60
10498	10/5/98	5.19	6027.31		6020.60
10592	1/13/98	22.60	5915.33		5913.93
10592	4/7/98	17.20	5920.73		5913.93
10592	7/2/98	19.76	5918.17		5913.93
10592	10/8/98	14.80	5923.13		5913.93
10594	1/12/98	8.50	5812.45	X	5813.05
10594	2/19/98	8.53	5812.42	X	5813.05
10594	4/7/98	3.37	5817.58		5813.05
10594	10/6/98	10.53	5810.42	X	5813.05
10598	9/17/98	4.97	6028.43		6025.30
10598	10/5/98	3.77	6029.63		6025.30
10692	1/13/98	4.41	5939.19		5924.20
10692	4/7/98	3.53	5940.07		5924.20
10692	7/2/98	4.69	5938.91		5924.20
10692	10/8/98	6.04	5937.56		5924.20
10694	1/12/98	5.89	5754.34	X	5754.53
10694	2/19/98	5.94	5754.29	X	5754.53
10694	4/7/98	5.12	5755.11		5754.53
10694	10/6/98	6.92	5753.31	X	5754.53
10792	1/13/98	23.74	5893.36	X	5894.70
10792	4/7/98	21.74	5895.36		5894.70
10792	7/2/98	23.04	5894.06	X	5894.70
10792	10/8/98	23.61	5893.49	X	5894.70
10794	1/5/98	6.78	5691.73	X	5694.01
10794	2/5/98	6.76	5691.75	X	5694.01
10794	3/4/98	6.78	5691.73	X	5694.01
10794	4/1/98	5.45	5693.06	X	5694.01
10794	5/5/98	5.82	5692.69	X	5694.01
10794	6/2/98	5.95	5692.56	X	5694.01
10794	6/17/98	6.77	5691.74	X	5694.01

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10794	7/1/98	6.80	5691.71	X	5694.01
1086	1/7/98	9.11	5989.08		5974.39
1086	2/5/98	9.55	5988.64		5974.39
1086	3/5/98	10.78	5987.41		5974.39
1086	4/7/98	2.58	5995.61		5974.39
1086	5/5/98	2.50	5995.69		5974.39
1086	6/2/98	5.06	5993.13		5974.39
1086	6/18/98	6.24	5991.95		5974.39
1086	7/1/98	7.64	5990.55		5974.39
1087	1/16/98			DRY	5971.52
1087	4/9/98			DRY	5971.52
1087	10/6/98			DRY	5971.52
10892	1/13/98			DRY	5905.80
10894	1/5/98	5.70	5663.21		5660.91
10894	4/13/98	4.20	5664.71		5660.91
10894	10/8/98	6.30	5662.61		5660.91
1090	5/8/98	11.53	5975.33		5956.86
10991	1/15/98	44.16	5897.48		5890.64
10992	1/13/98	29.77	5868.79	X	5869.16
10992	4/9/98	26.60	5871.96		5869.16
10992	7/2/98	23.72	5874.84		5869.16
10992	10/8/98	29.93	5868.63	X	5869.16
10994	1/13/98	16.00	5901.48		5900.28
10994	4/9/98	14.95	5902.53		5900.28
10994	5/18/98	15.30	5902.18		5900.28
10994	7/1/98	15.87	5901.61		5900.28
10994	10/6/98	16.52	5900.96		5900.28
11092	1/13/98	22.44	5872.87	X	5876.31
11092	4/9/98	22.42	5872.89	X	5876.31
11092	7/2/98	22.41	5872.90	X	5876.31
11092	10/8/98	21.91	5873.40	X	5876.31
11094	5/14/98	6.76	5905.61		5905.57
11294	1/7/98	20.33	6153.17		6097.30
11294	2/4/98	20.07	6153.43		6097.30
11294	3/2/98	20.30	6153.20		6097.30
11294	4/10/98	19.05	6154.45		6097.30
11294	5/5/98	17.32	6156.18		6097.30
11294	6/1/98	17.19	6156.31		6097.30
11294	7/2/98	18.35	6155.15		6097.30
11294	8/3/98	19.33	6154.17		6097.30
11294	9/2/98	19.90	6153.60		6097.30
11294	10/1/98	20.59	6152.91		6097.30
11294	11/2/98	21.18	6152.32		6097.30
11294	12/7/98	22.01	6151.49		6097.30
11494	1/7/98	19.19	6167.44		6119.63
11494	2/4/98	18.94	6167.69		6119.63
11494	3/2/98	19.39	6167.24		6119.63
11494	4/10/98	17.98	6168.65		6119.63
11494	5/5/98	16.81	6169.82		6119.63

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11494	6/1/98	16.65	6169.98		6119.63
11494	7/2/98	17.37	6169.26		6119.63
11494	8/3/98	17.95	6168.68		6119.63
11494	9/2/98	18.43	6168.20		6119.63
11494	10/1/98	18.95	6167.68		6119.63
11494	11/2/98	19.52	6167.11		6119.63
11494	12/7/98	20.20	6166.43		6119.63
11594	1/7/98	59.92	6056.41		6052.73
11594	2/4/98	59.22	6057.11		6052.73
11594	3/2/98	58.98	6057.35		6052.73
11594	4/10/98	59.31	6057.02		6052.73
11594	5/5/98	56.75	6059.58		6052.73
11594	6/1/98	52.31	6064.02		6052.73
11594	7/2/98	54.87	6061.46		6052.73
11594	8/3/98	57.22	6059.11		6052.73
11594	9/2/98	58.29	6058.04		6052.73
11594	10/1/98	58.91	6057.42		6052.73
11594	11/2/98	59.25	6057.08		6052.73
11594	12/7/98	59.59	6056.74		6052.73
11691	1/13/98	33.43	5906.48		5906.41
11691	1/13/98	33.43	5906.48		5906.41
11691	5/11/98	30.76	5909.15		5906.41
1187	1/8/98	18.59	5896.53		5894.82
11891	4/1/98	23.69	5923.75		5919.44
11891	5/11/98	20.42	5927.02		5919.44
11891	7/2/98	23.35	5924.09		5919.44
11891	10/8/98	25.87	5921.57		5919.44
1190	1/12/98	18.56	5982.52		5971.78
1190	2/3/98	18.52	5982.56		5971.78
1190	4/10/98	9.47	5991.61		5971.78
1190	5/8/98	8.03	5993.05		5971.78
1190	6/5/98	13.63	5987.45		5971.78
1190	7/8/98	16.04	5985.04		5971.78
1190	8/3/98	17.01	5984.07		5971.78
1190	9/3/98	17.93	5983.15		5971.78
1190	10/5/98	18.75	5982.33		5971.78
1190	11/2/98	19.23	5981.85		5971.78
1190	12/7/98	19.53	5981.55		5971.78
12094	1/12/98	5.78	5757.29		5753.07
12191	4/1/98	23.50	5934.69		5925.19
12191	7/9/98	19.66	5938.53		5925.19
12391	5/11/98	47.20	5894.50		5873.30
12491	1/13/98	27.61	5920.74		5888.35
12691	1/13/98	31.60	5919.48		5887.98
12691	4/1/98	32.29	5918.79		5887.98
12691	5/11/98	20.76	5930.32		5887.98
12691	7/2/98	24.99	5926.09		5887.98
12691	10/12/98	31.88	5919.20		5887.98
1290	1/12/98	24.76	5990.11		5979.87

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Appendix A

1290	4/10/98	17.17	5997.70		5979.87
1290	5/8/98	12.54	6002.33		5979.87
1290	10/5/98	24.48	5990.39		5979.87
13091	1/14/98	19.77	5955.43		5953.90
13091	4/6/98	13.25	5961.95		5953.90
13391	1/6/98	38.32	5887.03		5886.35
13391	4/13/98	38.12	5887.23		5886.35
13391	5/11/98	37.40	5887.95		5886.35
13391	10/12/98	37.73	5887.62		5886.35
13491	1/8/98	21.23	5942.19		5934.42
13491	4/1/98	19.50	5943.92		5934.42
13491	10/12/98	22.95	5940.47		5934.42
13591	1/14/98			DRY	5951.55
13591	4/6/98	17.16	5950.39	X	5951.55
1386	1/12/98	5.26	5837.33		5833.09
1386	2/5/98	5.31	5837.28		5833.09
1386	3/5/98	5.34	5837.25		5833.09
1386	4/7/98	4.02	5838.57		5833.09
1386	5/5/98	4.18	5838.41		5833.09
1386	6/2/98	5.45	5837.14		5833.09
1386	8/4/98	7.66	5834.93		5833.09
1386	9/1/98	9.31	5833.28		5833.09
1386	10/6/98	6.04	5836.55		5833.09
1386	11/3/98	5.61	5836.98		5833.09
1386	12/3/98	5.48	5837.11		5833.09
1390	1/12/98	28.93	5991.69		5981.62
1390	4/10/98	23.04	5997.58		5981.62
1390	5/8/98	17.57	6003.05		5981.62
1390	10/5/98	28.41	5992.21		5981.62
1486	2/18/98	9.82	5836.89		5791.31
1486	3/11/98	9.93	5836.78		5791.31
1486	4/9/98	10.06	5836.65		5791.31
1486	5/6/98	10.03	5836.68		5791.31
1486	6/5/98	10.26	5836.45		5791.31
1486	7/1/98	6.19	5840.52		5791.31
1487	1/8/98	14.77	5841.79		5832.46
1487	6/18/98	13.24	5843.32		5832.46
1487	7/1/98	13.53	5843.03		5832.46
1490	1/12/98	53.80	6017.48		6011.78
1490	2/4/98	53.61	6017.67		6011.78
1490	3/4/98	53.66	6017.62		6011.78
1490	4/10/98	53.60	6017.68		6011.78
1490	5/5/98	50.19	6021.09		6011.78
1490	6/1/98	48.13	6023.15		6011.78
1490	7/9/98	48.95	6022.33		6011.78
1490	8/3/98	49.69	6021.59		6011.78
1490	9/3/98	50.21	6021.07		6011.78
1490	10/5/98	50.92	6020.36		6011.78
1490	11/2/98	51.36	6019.92		6011.78

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1490	12/2/98	51.92	6019.36		6011.78
1586	1/12/98	6.78	5843.85		5836.23
1586	2/18/98	6.83	5843.80		5836.23
1586	3/11/98	6.74	5843.89		5836.23
1586	4/9/98	4.96	5845.67		5836.23
1586	5/6/98	5.27	5845.36		5836.23
1586	6/5/98	6.37	5844.26		5836.23
1587	1/14/98	20.40	5952.39		5950.69
1587	2/2/98	20.76	5952.03		5950.69
1587	3/2/98	21.47	5951.32		5950.69
1587	4/6/98	14.50	5958.29		5950.69
1587	5/6/98	12.22	5960.57		5950.69
1587	6/8/98	16.29	5956.50		5950.69
1587	7/6/98	18.84	5953.95		5950.69
1587	8/10/98	19.93	5952.86		5950.69
1587	9/8/98	20.97	5951.82		5950.69
1587	11/4/98	22.38	5950.41	X	5950.69
1587	12/4/98	21.83	5950.96		5950.69
1686	2/18/98	5.80	5863.75		5824.45
1786	1/12/98	6.86	5862.71		5855.57
1786	2/5/98	6.72	5862.85		5855.57
1786	3/5/98	3.83	5865.74		5855.57
1786	4/7/98	4.37	5865.20		5855.57
1786	5/5/98	5.34	5864.23		5855.57
1786	6/2/98	6.27	5863.30		5855.57
1786	7/1/98	6.53	5863.04		5855.57
1786	8/4/98	6.35	5863.22		5855.57
1786	9/1/98	6.55	5863.02		5855.57
1786	10/6/98	6.61	5862.96		5855.57
1786	11/3/98	6.45	5863.12		5855.57
1786	12/3/98	6.56	5863.01		5855.57
1886	1/12/98			DRY	5880.47
1886	4/7/98			DRY	5880.47
1886	10/6/98			DRY	5880.47
1986	1/7/98	2.75	5941.11		5931.56
1986	2/5/98	2.81	5941.05		5931.56
1986	3/3/98	2.91	5940.95		5931.56
1986	4/8/98	2.16	5941.70		5931.56
1986	5/6/98	2.35	5941.51		5931.56
1986	6/2/98	3.25	5940.61		5931.56
1986	7/7/98	3.72	5940.14		5931.56
1986	8/5/98	2.92	5940.94		5931.56
1986	9/2/98	3.60	5940.26		5931.56
1986	10/7/98	3.67	5940.19		5931.56
1986	11/2/98	2.98	5940.88		5931.56
1986	12/1/98	3.01	5940.85		5931.56
1987	1/13/98	11.68	5958.23		5958.21
1987	4/8/98	7.04	5962.87		5958.21
1987	10/5/98	12.85	5957.06	X	5958.21

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20196	4/10/98	40.16	6000.93		5975.79
20196	10/5/98	40.85	6000.24		5975.79
20197	5/14/98	2.73	5936.88		5933.01
20291	1/13/98	27.70	5920.88		5915.58
20291	2/9/98	27.41	5921.17		5915.58
20291	3/4/98	29.07	5919.51		5915.58
20291	4/1/98	28.21	5920.37		5915.58
20291	5/5/98	17.91	5930.67		5915.58
20291	6/4/98	18.40	5930.18		5915.58
20291	7/2/98	21.25	5927.33		5915.58
20291	8/4/98	24.06	5924.52		5915.58
20291	9/1/98	25.75	5922.83		5915.58
20291	10/12/98	27.97	5920.61		5915.58
20291	11/4/98	29.00	5919.58		5915.58
20291	12/7/98	30.13	5918.45		5915.58
20296	4/10/98	31.38	6004.83		5980.81
20296	5/8/98	24.94	6011.27		5980.81
20296	10/5/98	35.99	6000.22		5980.81
20396	4/10/98	26.22	6010.88		5986.40
20396	5/8/98	20.35	6016.75		5986.40
20396	10/5/98	32.63	6004.47		5986.40
20397	5/14/98	3.99	5936.65		5934.04
20496	4/10/98	44.56	6021.32		6001.38
20496	10/5/98	43.75	6022.13		6001.38
20596	4/10/98	55.58	6025.58		6010.06
20596	10/5/98	52.19	6028.97		6010.06
20597	5/14/98	8.04	5936.46		5934.30
20691	1/13/98	19.26	5950.37		5945.13
20691	2/9/98	20.18	5949.45		5945.13
20691	3/5/98	21.24	5948.39		5945.13
20691	4/8/98	10.30	5959.33		5945.13
20691	5/6/98	5.91	5963.72		5945.13
20691	6/3/98	9.96	5959.67		5945.13
20691	6/17/98	11.89	5957.74		5945.13
20691	7/8/98	15.11	5954.52		5945.13
20696	3/12/98	44.04	6011.98		5985.62
20696	4/10/98	41.60	6014.42		5985.62
20696	5/5/98	35.74	6020.28		5985.62
20696	6/1/98	36.19	6019.83		5985.62
20696	7/9/98	39.09	6016.93		5985.62
20696	8/3/98	40.24	6015.78		5985.62
20696	9/3/98	41.11	6014.91		5985.62
20696	10/5/98	41.98	6014.04		5985.62
20696	11/2/98	42.62	6013.40		5985.62
20696	12/2/98	43.21	6012.81		5985.62
20697	5/13/98	4.81	5961.99		5957.00
20796	4/10/98	43.88	6012.22		5976.10
20796	10/5/98	43.57	6012.53		5976.10
20797	5/18/98	3.61	5944.91		5939.92

20991	5/11/98	26.02	5925.37		5888.39
20991	6/17/98	27.79	5923.60		5888.39
20991	7/2/98	29.20	5922.19		5888.39
21097	5/14/98	3.47	5958.51		5953.98
21197	5/8/98	3.72	5933.75		5930.17
21297	5/8/98	1.46	5977.89		5973.45
21397	5/8/98	2.19	5973.11		5969.50
21497	5/8/98	1.18	5969.22		5963.00
21597	5/8/98	3.09	5962.58		5960.57
21697	5/8/98	4.24	5957.30		5952.84
21797	5/8/98	2.80	5954.60		5951.60
2186	1/12/98	31.71	5974.25		5938.76
2186	4/8/98	31.74	5974.22		5938.76
2186	7/7/98	32.17	5973.79		5938.76
2186	10/7/98	32.73	5973.23		5938.76
2187	1/7/98	2.98	5926.71		5919.29
2187	1/13/98	3.10	5926.59		5919.29
2187	4/8/98	2.45	5927.24		5919.29
2187	10/7/98	4.33	5925.36		5919.29
21897	5/8/98	3.43	5949.07		5946.60
21997	5/8/98	5.53	5944.97		5943.10
22097	5/8/98	4.45	5943.05		5940.60
22197	5/8/98	4.97	5939.53		5938.20
22297	5/8/98	1.98	5938.67		5937.65
22397	5/8/98			DRY	5932.80
22497	5/8/98	3.97	5939.03		5937.10
22596	2/5/98			DRY	5982.80
22596	3/3/98			DRY	5982.80
22596	4/8/98	22.71	5987.09		5982.80
22596	5/6/98	22.01	5987.79		5982.80
22596	6/2/98	24.07	5985.73		5982.80
22596	7/7/98			DRY	5982.80
22596	8/5/98	25.65	5984.15		5982.80
22596	9/1/98			DRY	5982.80
22596	10/7/98			DRY	5982.80
22596	11/3/98			DRY	5982.80
22596	12/1/98			DRY	5982.80
22597	1/8/98	17.46	5897.09		5888.55
22597	5/7/98	12.50	5902.05		5888.55
22696	1/6/98	14.83	5967.75		5965.08
22696	1/7/98	14.84	5967.74		5965.08
22696	4/8/98	11.04	5971.54		5965.08
22696	7/7/98	14.72	5967.86		5965.08
22696	10/7/98	18.55	5964.03	X	5965.08
22697	1/8/98	12.18	5895.33		5889.61
22697	5/7/98	8.56	5898.95		5889.61
22796	1/12/98			DRY	5927.50
22796	4/8/98	12.65	5931.85		5927.50
22796	7/7/98	14.24	5930.26		5927.50

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22796	10/7/98	14.88	5929.62		5927.50
22797	1/8/98	7.02	5892.48		5885.90
22797	5/7/98	4.43	5895.07		5885.90
2286	1/5/98	9.35	5970.20		5968.35
2286	2/5/98	9.64	5969.91		5968.35
2286	3/3/98	10.19	5969.36		5968.35
2286	4/8/98	5.26	5974.29		5968.35
2286	5/6/98	6.29	5973.26		5968.35
2286	6/2/98	7.33	5972.22		5968.35
2286	7/7/98	8.71	5970.84		5968.35
2286	8/5/98	7.66	5971.89		5968.35
2286	9/2/98	8.90	5970.65		5968.35
2286	10/7/98			DRY	5968.35
2286	11/3/98			DRY	5968.35
2286	12/2/98			DRY	5968.35
22896	1/6/98	20.84	5980.58		5978.12
22896	4/8/98	15.89	5985.53		5978.12
22896	7/7/98	20.89	5980.53		5978.12
22896	10/7/98	21.15	5980.27		5978.12
22897	1/8/98	13.89	5883.76		5873.55
22897	5/7/98	10.97	5886.68		5873.55
22996	1/6/98	6.60	5981.90		5980.00
22996	2/5/98	7.05	5981.45		5980.00
22996	3/4/98			DRY	5980.00
22996	4/8/98	4.27	5984.23		5980.00
22996	5/6/98	4.91	5983.59		5980.00
22996	6/3/98	5.88	5982.62		5980.00
22996	7/8/98	7.42	5981.08		5980.00
22996	8/4/98			DRY	5980.00
22996	9/8/98			DRY	5980.00
22996	10/6/98			DRY	5980.00
22996	11/5/98			DRY	5980.00
22996	12/7/98			DRY	5980.00
22997	1/8/98	8.85	5882.75		5875.60
22997	5/7/98	5.85	5885.75		5875.60
23096	1/13/98	9.47	5828.33		5823.80
23096	4/7/98	6.85	5830.95		5823.80
23096	6/18/98	12.22	5825.58		5823.80
23096	7/1/98	13.54	5824.26		5823.80
23096	10/6/98	12.91	5824.89		5823.80
23097	1/8/98	8.05	5879.43		5873.88
23097	5/7/98	5.43	5882.05		5873.88
23196	1/16/98	26.00	5790.67	X	5791.67
23196	4/7/98	26.86	5789.81	X	5791.67
23196	7/1/98	27.35	5789.32	X	5791.67
23196	10/6/98	28.01	5788.66	X	5791.67
23197	1/8/98	8.77	5877.09		5871.66
23197	5/7/98	6.50	5879.36		5871.66
23296	1/5/98	5.00	5853.00		5850.00

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23296	4/10/98	3.78	5854.22		5850.00
23296	5/12/98	3.42	5854.58		5850.00
23296	7/1/98	4.67	5853.33		5850.00
23296	10/6/98	5.44	5852.56		5850.00
23297	1/8/98	13.31	5868.46	X	5868.67
23297	5/7/98	11.53	5870.24		5868.67
23397	1/8/98	13.19	5866.40		5865.49
23397	5/7/98	10.98	5868.61		5865.49
23497	1/8/98			DRY	5864.26
23497	5/7/98	12.40	5864.06	X	5864.26
23597	1/8/98	13.76	5859.58		5854.14
23597	5/7/98	11.69	5861.65		5854.14
23697	1/8/98			DRY	5860.68
23697	5/7/98			DRY	5860.68
23797	1/8/98	17.40	5850.31		5847.71
23797	5/7/98	16.61	5851.10		5847.71
2386	2/16/98	99.31	5883.15		5865.16
23897	1/8/98	12.07	5850.28		5844.25
23897	5/7/98	11.73	5850.62		5844.25
23997	1/8/98			DRY	5843.73
23997	5/7/98	13.70	5847.93		5843.73
24097	5/7/98	15.17	5844.50		5841.57
24197	5/7/98	13.58	5844.02		5841.60
24297	1/8/98	5.90	5891.82		5888.62
24297	5/7/98	3.34	5894.38		5888.62
24397	1/8/98	9.08	5916.53		5907.31
24397	5/7/98	4.77	5920.84		5907.31
24497	1/8/98	12.30	5905.30		5900.70
24497	5/7/98	9.16	5908.44		5900.70
2486	1/7/98			DRY	5976.06
2486	4/2/98	6.83	5976.73		5976.06
2486	10/7/98			DRY	5976.06
2487	1/13/98	14.88	5944.81	X	5946.09
2487	4/1/98	12.70	5946.99		5946.09
2487	5/12/98	9.56	5950.13		5946.09
2487	10/12/98	15.53	5944.16	X	5946.09
25097	5/7/98	23.34	5911.16		5910.00
2586	1/5/98	17.95	5959.19		5895.14
2586	2/10/98	43.47	5933.67		5895.14
2587	5/12/98	11.76	5949.22		5917.48
2686	1/7/98	11.36	5965.81	X	5966.17
2686	2/10/98	11.58	5965.59	X	5966.17
2686	3/11/98	11.81	5965.36	X	5966.17
2686	4/2/98	9.42	5967.75		5966.17
2686	5/6/98	9.46	5967.71		5966.17
2686	6/5/98	10.70	5966.47		5966.17
2686	10/7/98	12.82	5964.35	X	5966.17
2687	1/14/98			DRY	5942.40
2687	4/6/98			DRY	5942.40

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Appendix A

26995	2/19/98	13.39	5922.81		5914.20
2786	2/10/98	103.49	5860.39		5830.88
28295	2/19/98	5.66	5846.44		5837.10
29395	2/16/98	3.68	5930.92		5922.60
29795	2/19/98	2.55	5844.75		5840.30
2986	1/7/98			DRY	5951.88
2986	4/2/98			DRY	5951.88
2986	10/7/98			DRY	5951.88
2987	1/16/98			DRY	5793.99
2987	4/7/98	12.56	5801.73		5793.99
2987	7/1/98	18.15	5796.14		5793.99
2987	10/6/98			DRY	5793.99
30595	2/19/98	9.10	5901.30		5888.40
30695	2/19/98	9.20	5911.60		5905.80
3086	2/11/98	6.12	5952.27		5943.49
3087	1/16/98	24.82	5786.95		5717.37
3087	4/7/98	29.55	5782.22		5717.37
3087	7/1/98	27.92	5783.85		5717.37
3087	10/6/98	25.07	5786.70		5717.37
308-P-1	5/8/98	23.71	5920.40		5904.11
308-P-2	5/8/98	24.77	5919.25		5904.02
31491	1/13/98			DRY	5886.13
31791	1/13/98			DRY	5868.00
3286	2/11/98	57.50	5910.42		5842.42
3286	3/11/98	53.34	5914.58		5842.42
3286	4/8/98	52.37	5915.55		5842.42
3286	5/6/98	52.12	5915.80		5842.42
3286	6/4/98	51.95	5915.97		5842.42
3287	1/14/98	47.63	5900.34	X	5901.37
3287	4/6/98	47.45	5900.52	X	5901.37
3386	1/5/98	8.10	5944.32	X	5945.12
3386	2/5/98	8.09	5944.33	X	5945.12
3386	3/3/98	8.27	5944.15	X	5945.12
3386	4/8/98	5.95	5946.47		5945.12
3386	5/6/98	6.36	5946.06		5945.12
3386	6/2/98	7.17	5945.25		5945.12
3386	7/7/98	8.19	5944.23	X	5945.12
3386	8/5/98	8.65	5943.77	X	5945.12
3386	9/2/98			DRY	5945.12
3386	10/7/98			DRY	5945.12
3386	11/2/98			DRY	5945.12
3386	12/2/98			DRY	5945.12
3387	1/14/98	20.60	5926.62	X	5927.22
3387	2/10/98	8.11	5939.11		5927.22
3387	4/6/98	20.05	5927.17	X	5927.22
34791	1/8/98	3.94	5949.97		5945.91
34791	4/9/98	1.18	5952.73		5945.91
34791	10/6/98	6.09	5947.82		5945.91
3586	1/13/98	7.70	5905.06		5901.16

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3586	2/9/98	7.61	5905.15		5901.16
3586	3/5/98	7.61	5905.15		5901.16
3586	4/8/98	4.49	5908.27		5901.16
3586	5/6/98	5.23	5907.53		5901.16
3586	6/3/98	6.97	5905.79		5901.16
3586	7/9/98	7.67	5905.09		5901.16
3586	8/6/98	7.54	5905.22		5901.16
3586	9/8/98	7.67	5905.09		5901.16
3586	10/5/98	7.71	5905.05		5901.16
3586	11/5/98	7.51	5905.25		5901.16
3586	12/7/98	7.88	5904.88		5901.16
3587	5/11/98			DRY	5941.99
3686	1/5/98	6.26	5878.96		5878.72
3686	2/5/98	6.18	5879.04		5878.72
3686	2/9/98	6.20	5879.02		5878.72
3686	3/4/98	6.26	5878.96		5878.72
3686	4/10/98	4.90	5880.32		5878.72
3686	5/5/98	4.00	5881.22		5878.72
3686	6/2/98	6.30	5878.92		5878.72
3686	6/17/98	5.60	5879.62		5878.72
3686	7/1/98	6.19	5879.03		5878.72
3687	1/13/98	34.06	5917.05		5887.71
3687	2/9/98	34.72	5916.39		5887.71
3687	3/4/98	35.23	5915.88		5887.71
3687	4/1/98	34.72	5916.39		5887.71
3687	5/5/98	26.97	5924.14		5887.71
3687	6/4/98	27.05	5924.06		5887.71
3687	7/2/98	29.22	5921.89		5887.71
3687	7/2/98	29.22	5921.89		5887.71
3687	8/4/98	31.57	5919.54		5887.71
3687	9/1/98	32.71	5918.40		5887.71
3687	10/12/98	34.41	5916.70		5887.71
3687	11/4/98	35.33	5915.78		5887.71
3687	12/7/98	35.82	5915.29		5887.71
37191	1/13/98	9.39	5938.90		5927.19
37191	4/9/98	7.41	5940.88		5927.19
37191	10/5/98	9.47	5938.82		5927.19
37591	1/7/98	10.38	5983.07		5980.85
37591	2/5/98	10.58	5982.87		5980.85
37591	3/5/98	10.91	5982.54		5980.85
37591	4/8/98	8.96	5984.49		5980.85
37591	5/6/98	7.71	5985.74		5980.85
37591	6/3/98	8.33	5985.12		5980.85
37591	6/18/98	8.74	5984.71		5980.85
37591	7/8/98	9.30	5984.15		5980.85
37691	1/7/98	18.27	5966.97	X	5968.74
37691	4/9/98	13.72	5971.52		5968.74
37691	10/6/98	18.30	5966.94	X	5968.74
37791	1/6/98	18.91	5985.27		5983.58

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37791	4/7/98	19.27	5984.91		5983.58
37791	10/6/98	16.24	5987.94		5983.58
38591	1/5/98	8.32	5858.30	X	5858.92
38591	4/9/98	7.14	5859.48		5858.92
38591	7/1/98	9.34	5857.28	X	5858.92
38591	10/6/98			DRY	5858.92
3986	1/6/98	28.08	5881.33		5877.91
3986	2/9/98	28.22	5881.19		5877.91
3986	3/4/98	28.35	5881.06		5877.91
3986	4/13/98	28.57	5880.84		5877.91
3986	5/4/98	25.47	5883.94		5877.91
3986	6/4/98	23.80	5885.61		5877.91
3986	8/4/98	25.14	5884.27		5877.91
3986	9/1/98	25.54	5883.87		5877.91
3986	10/12/98	25.89	5883.52		5877.91
3986	11/4/98	26.18	5883.23		5877.91
3986	12/7/98	26.83	5882.58		5877.91
3987	2/11/98	103.48	5844.94		5831.32
4087	1/12/98	2.51	5882.10		5878.11
4087	2/5/98	1.80	5882.81		5878.11
4087	3/5/98	2.79	5881.82		5878.11
4087	4/10/98	2.39	5882.22		5878.11
4087	5/5/98	2.39	5882.22		5878.11
4087	6/1/98	4.56	5880.05		5878.11
4087	7/1/98	5.46	5879.15		5878.11
4087	8/4/98	6.82	5877.79	X	5878.11
4087	9/1/98	8.25	5876.36	X	5878.11
4087	10/6/98			DRY	5878.11
4087	11/3/98			DRY	5878.11
4087	12/3/98			DRY	5878.11
41091	1/5/98	9.75	5712.10		5711.85
41091	2/5/98	10.01	5711.84	X	5711.85
41091	3/4/98	8.64	5713.21		5711.85
41091	4/7/98	5.23	5716.62		5711.85
41091	5/5/98	7.79	5714.06		5711.85
41091	6/2/98	7.25	5714.60		5711.85
41091	7/1/98	9.73	5712.12		5711.85
41091	8/4/98	9.24	5712.61		5711.85
41091	9/1/98	5.50	5716.35		5711.85
41091	10/6/98	9.83	5712.02		5711.85
41091	11/4/98	10.14	5711.71	X	5711.85
41091	12/3/98			DRY	5711.85
41193	2/11/98	7.99	5954.53		5954.52
41193	3/11/98	8.11	5954.41	X	5954.52
41193	4/8/98	4.11	5958.41		5954.52
41193	5/6/98	5.22	5957.30		5954.52
41193	6/4/98	7.26	5955.26		5954.52
41591	1/5/98	7.16	5720.11		5716.27
41591	2/9/98	7.69	5719.58		5716.27

41591	3/3/98	8.09	5719.18		5716.27
41591	4/13/98	4.37	5722.90		5716.27
41591	5/4/98	4.86	5722.41		5716.27
41591	6/4/98	6.57	5720.70		5716.27
41591	7/2/98	8.35	5718.92		5716.27
41591	8/4/98	8.91	5718.36		5716.27
41591	9/2/98	9.65	5717.62		5716.27
41591	10/8/98			DRY	5716.27
41591	11/3/98			DRY	5716.27
41591	12/4/98			DRY	5716.27
41691	1/5/98	8.68	5637.20		5631.18
41691	2/9/98	9.60	5636.28		5631.18
41691	3/3/98	8.20	5637.68		5631.18
41691	4/1/98	7.32	5638.56		5631.18
41691	5/4/98	7.82	5638.06		5631.18
41691	6/4/98	7.93	5637.95		5631.18
41691	7/2/98	9.83	5636.05		5631.18
41691	8/4/98	10.44	5635.44		5631.18
41691	9/2/98	7.34	5638.54		5631.18
41691	10/8/98	10.19	5635.69		5631.18
41691	11/3/98	10.55	5635.33		5631.18
41691	12/4/98	7.54	5638.34		5631.18
41693	2/11/98	13.50	5961.75		5959.25
41693	3/11/98	13.61	5961.64		5959.25
41693	4/8/98	13.04	5962.21		5959.25
41693	5/6/98	12.74	5962.51		5959.25
41693	6/4/98	12.59	5962.66		5959.25
4186	1/14/98	46.31	5898.05	X	5899.66
4186	2/2/98	46.35	5898.01	X	5899.66
4186	3/2/98	46.39	5897.97	X	5899.66
4186	4/6/98	46.45	5897.91	X	5899.66
4186	5/7/98	45.12	5899.24	X	5899.66
4186	6/8/98	42.20	5902.16		5899.66
4186	7/6/98	41.38	5902.98		5899.66
4186	8/10/98	41.52	5902.84		5899.66
41993	2/16/98	14.45	5963.89		5963.84
42393	2/16/98	14.08	5967.88	X	5968.96
42393	3/11/98	14.68	5967.28	X	5968.96
42393	4/1/98	10.30	5971.66		5968.96
42393	5/6/98	10.29	5971.67		5968.96
42393	6/5/98	10.39	5971.57		5968.96
4286	1/8/98	26.80	5931.07		5928.17
4286	2/9/98	22.03	5935.84		5928.17
4286	3/4/98	22.83	5935.04		5928.17
4286	4/1/98	20.31	5937.56		5928.17
4286	5/5/98	10.11	5947.76		5928.17
4286	6/4/98	11.09	5946.78		5928.17
4286	7/2/98	15.22	5942.65		5928.17
4286	8/4/98	19.19	5938.68		5928.17

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4286	9/3/98	20.87	5937.00		5928.17
4286	10/12/98	22.86	5935.01		5928.17
4286	11/4/98	23.63	5934.24		5928.17
4286	12/7/98	24.77	5933.10		5928.17
42993	2/16/98	12.18	5968.57		5964.75
42993	3/11/98	12.63	5968.12		5964.75
42993	4/8/98	8.89	5971.86		5964.75
42993	5/6/98	8.57	5972.18		5964.75
42993	6/5/98	9.61	5971.14		5964.75
43293	2/11/98			DRY	5944.14
43392	1/13/98	28.18	6015.26		6013.14
43392	4/9/98	24.41	6019.03		6013.14
43392	7/1/98	28.03	6015.41		6013.14
43392	10/6/98	30.15	6013.29		6013.14
43593	2/16/98	8.75	5971.19		5968.94
4386	1/13/98	17.67	5956.79	X	5957.66
4386	2/9/98	18.13	5956.33	X	5957.66
4386	3/5/98			DRY	5957.66
4386	4/9/98	12.50	5961.96		5957.66
4386	5/6/98	11.85	5962.61		5957.66
4386	6/3/98	13.94	5960.52		5957.66
4386	7/8/98	16.48	5957.98		5957.66
4386	8/4/98	17.13	5957.33	X	5957.66
4386	9/8/98	18.11	5956.35	X	5957.66
4386	10/5/98			DRY	5957.66
4386	11/5/98			DRY	5957.66
4386	12/7/98	18.31	5956.15	X	5957.66
4387	1/13/98	9.63	5916.78		5914.11
4387	4/9/98	6.22	5920.19		5914.11
4387	10/5/98	8.78	5917.63		5914.11
43893	2/16/98	12.75	5967.34		5966.09
43995	2/16/98	10.91			
4486	1/6/98	7.48	6014.48		5995.66
4486	4/8/98	5.72	6016.24		5995.66
4486	9/17/98	7.23	6014.73		5995.66
4486	10/6/98	7.35	6014.61		5995.66
4487	1/13/98			DRY	5947.60
44893	1/13/98			DRY	5913.83
44893	2/5/98			DRY	5913.83
44893	3/4/98			DRY	5913.83
44893	4/7/98			DRY	5913.83
44893	5/5/98			DRY	5913.83
44893	6/2/98			DRY	5913.83
44893	7/1/98			DRY	5913.83
44893	8/4/98			DRY	5913.83
44893	9/1/98			DRY	5913.83
44893	10/6/98			DRY	5913.83
44893	11/3/98			DRY	5913.83
44893	12/3/98			DRY	5913.83

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Appendix A

45093	2/18/98	11.96	5917.90	X	5918.16
45391	1/13/98			DRY	5876.54
45393	2/18/98	13.26	5912.40		5908.96
45393	3/11/98	13.58	5912.08		5908.96
45393	4/9/98	13.91	5911.75		5908.96
45393	5/6/98	14.27	5911.39		5908.96
45393	6/5/98	14.63	5911.03		5908.96
45693	2/11/98	3.29	5935.52		5933.31
45793	1/12/98			DRY	5949.12
45793	2/11/98			DRY	5949.12
45793	4/8/98	6.84	5946.28	X	5949.12
45793	10/7/98	6.89	5946.23	X	5949.12
45893	2/11/98			DRY	5944.50
45993	2/11/98			DRY	5947.81
46193	2/11/98	3.88	5934.82		5931.70
46292	1/7/98	54.81	6042.43		6006.74
46292	4/10/98	54.61	6042.63		6006.74
46292	10/1/98	51.03	6046.21		6006.74
46293	1/12/98	3.13	5938.46		5933.59
46293	2/5/98	3.45	5938.14		5933.59
46293	2/16/98	3.35	5938.24		5933.59
46293	3/3/98	4.23	5937.36		5933.59
46293	4/8/98	0.20	5941.39		5933.59
46293	5/6/98	0.00	5941.59		5933.59
46293	6/2/98	1.93	5939.66		5933.59
46293	7/7/98	4.91	5936.68		5933.59
46293	8/5/98	4.04	5937.55		5933.59
46393	2/19/98	20.83	5881.91		5880.24
46492	1/8/98	24.18	6032.63		6013.61
46492	4/10/98	21.70	6035.11		6013.61
46492	9/17/98	23.96	6032.85		6013.61
46492	10/1/98	24.63	6032.18		6013.61
4686	1/8/98	73.70	6010.29		5923.19
4786	1/8/98	59.08	6024.59		5989.17
4786	2/3/98	59.10	6024.57		5989.17
4786	3/2/98	59.04	6024.63		5989.17
4786	4/10/98	59.01	6024.66		5989.17
4786	5/5/98	57.28	6026.39		5989.17
4786	6/1/98	55.48	6028.19		5989.17
4786	6/16/98	54.93	6028.74		5989.17
4786	7/8/98	55.12	6028.55		5989.17
4786	8/10/98	55.32	6028.35		5989.17
4787	1/13/98			DRY	5877.34
4787	4/9/98	3.93	5880.71		5877.34
4787	7/2/98	8.52	5876.12	X	5877.34
4787	10/8/98			DRY	5877.34
4887	1/13/98	10.36	5901.05	X	5901.31
4887	4/9/98	5.91	5905.50		5901.31
4887	7/2/98	10.24	5901.17	X	5901.31

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4887	10/8/98			DRY	5901.31
50494	1/7/98			DRY	6072.64
50494	4/10/98			DRY	6072.64
50494	10/1/98	24.61	6069.73	X	6072.64
50694	1/8/98	24.28	6063.22		6060.70
50694	4/10/98	23.81	6063.69		6060.70
50694	10/1/98	20.59	6066.91		6060.70
5087	1/13/98			DRY	5921.28
51094	1/5/98	44.50	6048.75		6035.55
51094	4/10/98	44.22	6049.03		6035.55
51094	10/1/98	40.74	6052.51		6035.55
51194	1/8/98	37.84	6035.47		6023.31
51194	4/10/98	36.80	6036.51		6023.31
51194	10/1/98	34.86	6038.45		6023.31
51294	1/8/98	21.86	6042.82		6029.68
51294	2/4/98	21.58	6043.10		6029.68
51294	3/4/98	21.71	6042.97		6029.68
51294	4/10/98	21.07	6043.61		6029.68
51294	5/5/98	18.47	6046.21		6029.68
51294	6/1/98	17.00	6047.68		6029.68
51294	8/4/98	18.04	6046.64		6029.68
51294	8/6/98	17.90	6046.78		6029.68
51294	9/3/98	18.22	6046.46		6029.68
51294	10/1/98	19.01	6045.67		6029.68
51294	11/2/98	19.82	6044.86		6029.68
51294	12/2/98	20.27	6044.41		6029.68
51494	1/7/98	51.64	6047.62		6030.56
51494	2/3/98	51.60	6047.66		6030.56
51494	3/2/98	51.37	6047.89		6030.56
51494	4/10/98	51.38	6047.88		6030.56
51494	5/5/98	49.86	6049.40		6030.56
51494	6/1/98	48.18	6051.08		6030.56
51494	6/16/98	47.39	6051.87		6030.56
51594	1/7/98	8.92	6090.57		6079.49
51594	2/3/98	8.67	6090.82		6079.49
51594	3/2/98	8.42	6091.07		6079.49
51594	4/10/98	7.58	6091.91		6079.49
51594	5/5/98	6.53	6092.96		6079.49
51594	6/1/98	6.42	6093.07		6079.49
51594	7/9/98	7.56	6091.93		6079.49
51594	8/3/98	8.13	6091.36		6079.49
51594	9/3/98	8.87	6090.62		6079.49
51594	10/1/98	9.60	6089.89		6079.49
51594	11/2/98	10.89	6088.60		6079.49
51594	12/7/98	12.38	6087.11		6079.49
5287	1/6/98	9.86	5959.71		5949.27
5287	2/5/98	9.76	5959.81		5949.27
5287	3/3/98	9.89	5959.68		5949.27
5287	4/7/98	9.11	5960.46		5949.27

5287	5/7/98	9.20	5960.37		5949.27
5287	6/3/98	9.62	5959.95		5949.27
5287	7/8/98	9.77	5959.80		5949.27
5287	8/4/98	9.59	5959.98		5949.27
5287	9/8/98	9.75	5959.82		5949.27
5287	10/5/98	9.92	5959.65		5949.27
5287	11/4/98	9.73	5959.84		5949.27
5287	12/2/98	9.89	5959.68		5949.27
52893	5/13/98			DRY	5934.50
52894	1/12/98	4.48	5866.27	X	5866.75
52894	4/10/98	3.29	5867.46		5866.75
52894	7/1/98	6.15	5864.60	X	5866.75
52894	10/6/98	7.98	5862.77	X	5866.75
52993	5/13/98			DRY	5931.00
52994	1/12/98			DRY	5858.81
52994	4/10/98			DRY	5858.81
52994	7/1/98	18.73	5855.08	X	5858.81
52994	10/6/98			DRY	5858.81
53093	5/13/98			DRY	5935.70
53193	5/13/98			DRY	5938.50
53194	1/12/98	3.65	5835.73		5832.38
53293	5/18/98			DRY	5942.80
53393	5/13/98			DRY	5914.70
53493	5/18/98	5.04	5900.36		5895.40
5387	1/16/98	5.90	5955.91		5952.71
5387	4/9/98	3.16	5958.65		5952.71
5387	7/2/98	7.32	5954.49		5952.71
5387	10/8/98	8.50	5953.31		5952.71
5586	1/5/98	21.90	6096.82		6082.32
5586	2/4/98	21.65	6097.07		6082.32
5586	3/2/98	22.55	6096.17		6082.32
5586	4/1/98	17.82	6100.90		6082.32
5586	5/4/98	10.10	6108.62		6082.32
5586	6/1/98	13.07	6105.65		6082.32
5586	6/16/98	15.61	6103.11		6082.32
5586	7/1/98	17.93	6100.79		6082.32
5587	1/5/98	8.75	5851.34	X	5852.69
5587	2/4/98	8.05	5852.04	X	5852.69
5587	3/2/98	7.80	5852.29	X	5852.69
5587	4/9/98	6.10	5853.99		5852.69
5587	5/4/98			DRY	5852.69
5587	6/1/98	8.07	5852.02	X	5852.69
5587	7/1/98	7.84	5852.25	X	5852.69
5587	8/4/98	8.14	5851.95	X	5852.69
5587	9/2/98	8.62	5851.47	X	5852.69
5587	10/6/98	9.35	5850.74	X	5852.69
5587	11/3/98			DRY	5852.69
5587	12/1/98	8.40	5851.69	X	5852.69
5686	1/13/98	6.82	5982.11		5979.33

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5686	2/9/98	6.54	5982.39		5979.33
5686	3/3/98	6.30	5982.63		5979.33
5686	4/1/98	4.28	5984.65		5979.33
5686	5/4/98	5.50	5983.43		5979.33
5686	6/1/98	6.64	5982.29		5979.33
5686	7/1/98	6.80	5982.13		5979.33
5686	8/6/98	6.84	5982.09		5979.33
5686	9/2/98	6.83	5982.10		5979.33
5686	10/6/98	6.87	5982.06		5979.33
5686	11/3/98	6.82	5982.11		5979.33
5686	12/1/98	6.84	5982.09		5979.33
5687	2/10/98	8.50	5971.27		5970.07
56994	1/16/98	17.30	6004.33		5997.13
56994	4/1/98	16.40	6005.23		5997.13
56994	5/21/98	14.92	6006.71		5997.13
56994	10/6/98	17.09	6004.54		5997.13
57094	1/13/98	33.37	5938.75		5938.12
57094	4/1/98	33.28	5938.84		5938.12
57094	5/13/98	32.73	5939.39		5938.12
57094	10/6/98	34.21	5937.91	X	5938.12
57594	5/13/98	8.10	5940.33		5858.53
57994	5/14/98	4.75	5936.52		5934.27
58094	5/13/98	4.17	5926.74		5919.91
58194	5/13/98	3.58	5927.05		5922.63
58294	5/14/98	7.32	5941.49	X	5943.81
58394	5/21/98	6.48	5993.06	X	5994.14
58494	5/21/98	3.17	5993.21		5986.38
58594	5/13/98	5.31	5914.83		5914.14
58694	5/13/98	5.48	5954.48	X	5954.96
58793	1/13/98	14.50	5999.70		5989.40
58793	4/1/98	12.38	6001.82		5989.40
58793	7/1/98	9.41	6004.79		5989.40
58793	10/6/98	13.86	6000.34		5989.40
58794	5/18/98	5.00	5953.91		5953.91
5887	1/7/98	9.53	5987.24		5974.47
5887	4/7/98	4.41	5992.36		5974.47
5887	5/8/98	4.30	5992.47		5974.47
5887	7/1/98	8.46	5988.31		5974.47
5887	10/5/98	11.85	5984.92		5974.47
59393	1/13/98	7.24	5947.46		5947.20
59394	5/13/98	32.23	5934.73		5879.46
59493	1/15/98	4.52	5987.88		5979.50
59493	4/1/98	4.08	5988.32		5979.50
59493	7/1/98	5.81	5986.59		5979.50
59493	10/6/98	9.63	5982.77		5979.50
59594	1/13/98	28.04	6020.87		6011.31
59594	4/1/98	25.30	6023.61		6011.31
59594	10/6/98	31.26	6017.65		6011.31
59793	5/13/98	8.21	5937.59		5932.10

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59893	1/16/98	4.42	5941.98		5931.80
59893	4/1/98	2.70	5943.70		5931.80
59893	5/18/98	3.72	5942.68		5931.80
59893	10/6/98	9.40	5937.00		5931.80
59993	5/18/98	7.23	5937.07		5928.00
60093	5/13/98	9.90	5935.50	X	5935.60
60193	5/13/98			DRY	5939.20
60195	1/8/98	5.65	5894.35		5889.00
60195	2/5/98	5.98	5894.02		5889.00
60195	3/4/98	6.29	5893.71		5889.00
60195	4/10/98	4.05	5895.95		5889.00
60195	5/5/98	3.11	5896.89		5889.00
60195	6/2/98	3.62	5896.38		5889.00
60195	7/1/98	4.50	5895.50		5889.00
60195	8/6/98	5.29	5894.71		5889.00
60195	9/1/98	6.15	5893.85		5889.00
60195	10/6/98	6.62	5893.38		5889.00
60195	11/4/98	6.78	5893.22		5889.00
60195	12/3/98	6.54	5893.46		5889.00
60294	1/14/98	Well Not found			
60294	4/9/98	2.60	5919.23		
60295	1/8/98	4.57	5892.43		5880.80
60295	4/10/98	3.26	5893.74		5880.80
60295	5/11/98	2.10	5894.90		5880.80
60295	10/6/98	5.46	5891.54		5880.80
60395	1/8/98	5.75	5881.25		5878.70
60395	4/10/98	3.94	5883.06		5878.70
60395	5/11/98	3.28	5883.72		5878.70
60395	10/6/98	6.89	5880.11		5878.70
60693	1/15/98	14.40	6009.30		6005.90
60693	4/1/98			DRY	6005.90
60693	7/1/98	15.90	6007.80		6005.90
60693	10/6/98	16.14	6007.56		6005.90
60695	1/6/98	9.35	5875.65		5871.10
60695	4/13/98	8.49	5876.51		5871.10
60695	5/11/98	6.18	5878.82		5871.10
60695	10/12/98	8.20	5876.80		5871.10
60795	1/16/98			DRY	5833.90
60795	4/13/98			DRY	5833.90
60795	5/11/98	2.00	5840.00		5833.90
60795	10/12/98	8.14	5833.86	X	5833.90
6087	1/7/98	10.60	5975.36		5958.46
6087	4/7/98	4.85	5981.11		5958.46
6087	5/8/98	5.00	5980.96		5958.46
6087	10/6/98	12.12	5973.84		5958.46
60895	5/11/98			DRY	5830.10
60993	5/21/98	3.53	5983.37		5978.90
60994	1/14/98			DRY	5920.77
60994	1/16/98			DRY	5920.77

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60994	4/9/98	3.28	5928.79		5920.77
60994	10/8/98			DRY	5920.77
61093	5/21/98	4.81	5968.79		5960.60
61293	1/15/98	2.10	5984.60		5978.70
61293	4/1/98	2.05	5984.65		5978.70
61293	7/1/98	5.77	5980.93		5978.70
61293	10/6/98	8.75	5977.95	X	5978.70
61295	1/13/98	3.58	5863.42		5856.60
61295	4/13/98	2.62	5864.38		5856.60
61295	10/6/98	4.11	5862.89		5856.60
61495	1/16/98	5.84	5972.16		5965.80
61495	4/10/98	2.91	5975.09		5965.80
61495	5/8/98	3.14	5974.86		5965.80
61495	10/5/98	6.66	5971.34		5965.80
61595	1/16/98	2.84	5970.16		5962.10
61595	4/10/98	0.93	5972.07		5962.10
61595	5/8/98	1.36	5971.64		5962.10
61595	10/5/98	3.72	5969.28		5962.10
61695	1/16/98	3.33	5984.67		5973.60
61695	4/10/98	1.61	5986.39		5973.60
61695	5/8/98	1.59	5986.41		5973.60
61695	10/5/98	4.30	5983.70		5973.60
61793	5/14/98	4.50	5914.20		5912.80
6186	1/6/98	10.31	5990.29		5988.60
6186	4/7/98	7.25	5993.35		5988.60
6186	7/8/98	10.18	5990.42		5988.60
6186	10/6/98	9.98	5990.62		5988.60
61893	5/14/98	0.00	5946.20		5937.40
61993	5/14/98	5.96	5929.54		5929.50
62395	1/6/98			DRY	
62395	2/9/98			DRY	
62395	3/4/98			DRY	
62395	4/8/98	2.12			
62395	5/4/98	7.55			
62395	6/4/98	8.48			
62395	8/4/98	9.02			
62395	9/1/98	9.35			
62395	10/12/98	9.31			
62395	11/4/98	9.21			
62395	12/7/98	9.26			
62593	1/15/98	4.40	6043.40		6039.40
62593	2/9/98	2.97	6044.83		6039.40
62593	3/3/98	3.53	6044.27		6039.40
62593	4/1/98	0.56	6047.24		6039.40
62593	5/4/98	0.56	6047.24		6039.40
62593	6/2/98	2.79	6045.01		6039.40
62593	7/1/98	4.21	6043.59		6039.40
62593	8/10/98	5.71	6042.09		6039.40
62593	9/2/98	6.75	6041.05		6039.40

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62593	10/6/98	7.33	6040.47		6039.40
62593	11/3/98	7.35	6040.45		6039.40
62593	12/1/98	6.40	6041.40		6039.40
62693	1/15/98	1.84	6039.96		6033.20
62693	2/9/98	1.34	6040.46		6033.20
62693	3/3/98	1.93	6039.87		6033.20
62693	4/1/98	0.00	6041.80		6033.20
62693	5/4/98	0.00	6041.80		6033.20
62693	6/2/98	2.97	6038.83		6033.20
62693	7/1/98	4.43	6037.37		6033.20
62693	8/10/98	6.11	6035.69		6033.20
62693	9/2/98	7.60	6034.20		6033.20
62693	10/6/98	7.94	6033.86		6033.20
62693	11/3/98	7.70	6034.10		6033.20
62693	12/1/98	4.96	6036.84		6033.20
62793	5/14/98			DRY	5927.70
6286	1/8/98	29.31	5873.87		5867.98
6286	4/9/98	29.13	5874.05		5867.98
6286	7/2/98	27.61	5875.57		5867.98
6286	10/8/98	27.25	5875.93		5867.98
62893	1/15/98	0.75	5994.45		5980.40
62893	4/1/98	0.00	5995.20		5980.40
62893	5/18/98	0.70	5994.50		5980.40
62893	10/6/98	1.80	5993.40		5980.40
63193	5/13/98			DRY	5948.90
63395	1/5/98	7.16	5892.84		5892.00
63395	4/10/98	6.72	5893.28		5892.00
63395	5/12/98	4.57	5895.43		5892.00
63395	10/6/98	7.18	5892.82		5892.00
63495	1/16/98	2.86	6008.14		6003.20
63495	4/13/98	2.10	6008.90		6003.20
63495	5/8/98	2.10	6008.90		6003.20
63495	10/5/98	3.51	6007.49		6003.20
63795	1/12/98	4.90			
63795	2/3/98	5.50			
63795	3/4/98	4.99			
63795	4/10/98	3.44			
63795	5/5/98	4.10			
63795	6/1/98	4.91			
63795	7/8/98	6.44			
63795	8/3/98	7.61			
63795	9/3/98	9.96			
63795	10/5/98	9.68			
63795	11/2/98	9.35			
63795	12/7/98	8.96			
6386	1/8/98	15.22	5886.79		5886.71
6386	4/9/98	13.63	5888.38		5886.71
6386	7/2/98	9.65	5892.36		5886.71
6386	10/8/98	15.84	5886.17	X	5886.71

63895	1/12/98	5.60			
63895	2/3/98	5.57			
63895	3/4/98	5.60			
63895	4/10/98	4.12			
63895	5/5/98	4.15			
63895	6/1/98	4.44			
63895	7/8/98	4.80			
63895	8/3/98	4.85			
63895	9/3/98	5.21			
63895	10/5/98	5.27			
63895	11/2/98	5.33			
63895	12/7/98	5.60			
64595	1/16/98			DRY	5787.80
64595	2/9/98			DRY	5787.80
64595	3/4/98			DRY	5787.80
64595	4/7/98			DRY	5787.80
64595	5/4/98			DRY	5787.80
6486	1/13/98	7.08	5833.97		5832.05
6486	2/4/98	7.04	5834.01		5832.05
6486	3/2/98	7.22	5833.83		5832.05
6486	4/7/98	6.47	5834.58		5832.05
6486	5/4/98	7.82	5833.23		5832.05
6486	6/1/98	7.53	5833.52		5832.05
6486	7/1/98	8.42	5832.63		5832.05
6486	8/4/98			DRY	5832.05
6486	9/2/98	11.21	5829.84	X	5832.05
6486	10/6/98			DRY	5832.05
6486	11/3/98			DRY	5832.05
6486	12/1/98	10.82	5830.23	X	5832.05
6586	1/16/98			DRY	5780.27
6586	3/2/98			DRY	5780.27
6586	4/7/98	7.81	5780.46		5780.27
6586	5/5/98	6.00	5782.27		5780.27
6586	6/1/98			DRY	5780.27
6586	7/1/98			DRY	5780.27
6586	8/4/98			DRY	5780.27
6586	9/2/98			DRY	5780.27
6586	10/6/98			DRY	5780.27
6586	11/3/98	6.15	5782.12		5780.27
6586	12/1/98	6.01	5782.26		5780.27
6587	2/4/98	8.05	5976.94		5960.99
6686	1/5/98	4.45	5689.75		5687.70
6686	2/4/98	4.37	5689.83		5687.70
6686	3/3/98	4.64	5689.56		5687.70
6686	4/13/98	4.72	5689.48		5687.70
6686	5/4/98	4.88	5689.32		5687.70
6686	6/4/98	5.14	5689.06		5687.70
6686	7/2/98	6.62	5687.58	X	5687.70
6686	8/4/98	7.32	5686.88	X	5687.70

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6686	9/1/98	7.53	5686.67	X	5687.70
6686	10/8/98	8.13	5686.07	X	5687.70
6686	11/3/98	4.49	5689.71		5687.70
6686	12/4/98	4.86	5689.34		5687.70
6774	5/8/98	2.64	6047.50		5993.14
6786	1/16/98			DRY	5789.17
6786	4/7/98			DRY	5789.17
6786	10/8/98	15.99	5787.98	X	5789.17
68194	9/17/98	6.64	6020.46		6009.10
68494	1/16/98	6.50	6017.87		6009.17
68494	9/17/98	6.18	6018.19		6009.17
6886	1/16/98	3.50	5886.99		5886.99
6886	3/12/98	3.49	5887.00		5886.99
6886	4/9/98	3.29	5887.20		5886.99
6886	5/4/98	3.55	5886.94	X	5886.99
6886	6/1/98	3.81	5886.68	X	5886.99
6886	6/18/98	3.82	5886.67	X	5886.99
6886	7/1/98	4.01	5886.48	X	5886.99
70093	1/7/98	12.50	5980.40		5970.90
70093	5/8/98	4.55	5988.35		5970.90
70193	1/7/98	12.12	5979.88		5954.70
70193	4/7/98	5.21	5986.79		5954.70
70193	7/1/98	10.18	5981.82		5954.70
70193	10/6/98	12.76	5979.24		5954.70
70393	1/7/98	9.71	5990.39		5977.30
70393	1/7/98	9.71	5990.39		5977.30
70393	4/7/98	3.81	5996.29		5977.30
70393	5/8/98	3.05	5997.05		5977.30
70393	7/1/98	8.05	5992.05		5977.30
70393	10/5/98	12.03	5988.07		5977.30
70493	1/7/98	9.70	5990.30		5956.00
70493	4/7/98	5.48	5994.52		5956.00
70493	7/1/98	10.16	5989.84		5956.00
70493	10/5/98	11.16	5988.84		5956.00
70593	1/7/98	30.99	5969.01		5864.00
70693	1/7/98	16.08	5976.62		5964.30
70693	4/7/98	6.67	5986.03		5964.30
70693	5/8/98	7.36	5985.34		5964.30
70693	10/5/98	17.62	5975.08		5964.30
7086	1/16/98	3.13	5936.26		5931.49
7086	4/7/98	2.66	5936.73		5931.49
7086	5/13/98	3.21	5936.18		5931.49
7086	7/1/98	4.65	5934.74		5931.49
7086	10/6/98	4.48	5934.91		5931.49
7187	1/7/98	6.90	5958.59		5951.99
7187	4/7/98	4.26	5961.23		5951.99
7187	10/6/98	8.61	5956.88		5951.99
75292	1/5/98	6.42	5750.48		5749.30
75292	2/5/98	5.64	5751.26		5749.30

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75292	2/19/98	6.96	5749.94		5749.30
75292	3/4/98	7.24	5749.66		5749.30
75292	4/7/98	4.15	5752.75		5749.30
75292	5/5/98	4.51	5752.39		5749.30
75292	6/2/98	4.61	5752.29		5749.30
75292	7/1/98	8.66	5748.24	X	5749.30
75292	8/4/98	8.02	5748.88	X	5749.30
75292	9/1/98	8.91	5747.99	X	5749.30
75292	10/6/98	8.16	5748.74	X	5749.30
75292	11/4/98	5.57	5751.33		5749.30
75292	12/3/98	6.45	5750.45		5749.30
75992	1/5/98	7.80	5891.30		5889.10
75992	1/5/98	7.80	5891.30		5889.10
75992	4/13/98	5.78	5893.32		5889.10
75992	5/11/98	5.82	5893.28		5889.10
75992	7/1/98	7.76	5891.34		5889.10
75992	10/6/98	8.79	5890.31		5889.10
76292	1/7/98	18.55	5940.75		5940.10
76292	2/11/98	19.16	5940.14		5940.10
76292	3/11/98	19.57	5939.73	X	5940.10
76292	4/8/98	10.21	5949.09		5940.10
76292	5/6/98	9.09	5950.21		5940.10
76292	6/4/98	12.37	5946.93		5940.10
76792	1/12/98	6.93	5938.57	X	5940.00
76792	4/7/98	2.22	5943.28		5940.00
76792	5/8/98	2.50	5943.00		5940.00
76792	10/6/98	7.19	5938.31	X	5940.00
76992	1/12/98	9.87	5948.13	X	5948.60
76992	4/7/98	6.11	5951.89		5948.60
76992	5/8/98	7.30	5950.70		5948.60
76992	7/1/98	10.01	5947.99	X	5948.60
76992	10/6/98	12.06	5945.94	X	5948.60
77192	5/8/98	2.32	5913.58		5910.00
77392	1/12/98			DRY	5958.60
77392	4/7/98	5.22	5960.28		5958.60
77392	5/8/98	4.19	5961.31		5958.60
77392	7/1/98	8.51	5956.99	X	5958.60
77392	10/6/98	10.13	5955.37	X	5958.60
77492	1/6/98	13.82	5930.68		5922.40
77492	2/5/98	13.90	5930.60		5922.40
77492	3/3/98	14.03	5930.47		5922.40
77492	4/2/98	12.80	5931.70		5922.40
77492	5/6/98	11.94	5932.56		5922.40
77492	6/2/98	12.24	5932.26		5922.40
77492	6/17/98	12.16	5932.34		5922.40
77492	7/7/98	12.49	5932.01		5922.40
B102289	1/12/98	2.88	5977.18		5967.56
B102289	4/10/98	2.95	5977.11		5967.56
B102289	10/5/98	3.02	5977.04		5967.56

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B102389	1/12/98	4.76	5936.42		5930.28
B102389	4/10/98	3.73	5937.45		5930.28
B102389	10/5/98	7.29	5933.89		5930.28
B110889	1/8/98	35.82	6041.95		6012.97
B110889	4/10/98	35.29	6042.48		6012.97
B110889	10/1/98	32.68	6045.09		6012.97
B110989	1/8/98	47.98	6036.38		6018.76
B110989	2/3/98	48.11	6036.25		6018.76
B110989	3/2/98	47.98	6036.38		6018.76
B110989	4/10/98	47.74	6036.62		6018.76
B110989	5/5/98	45.39	6038.97		6018.76
B110989	6/1/98	43.68	6040.68		6018.76
B110989	7/9/98	43.68	6040.68		6018.76
B110989	8/3/98	44.09	6040.27		6018.76
B110989	9/3/98	44.24	6040.12		6018.76
B110989	10/1/98	44.77	6039.59		6018.76
B110989	11/2/98	45.25	6039.11		6018.76
B110989	12/7/98	46.10	6038.26		6018.76
B111189	1/7/98	59.00	6048.52		6034.92
B111189	2/3/98	59.04	6048.48		6034.92
B111189	3/2/98	58.85	6048.67		6034.92
B111189	4/10/98	58.95	6048.57		6034.92
B111189	5/5/98	58.38	6049.14		6034.92
B111189	6/1/98	57.78	6049.74		6034.92
B111189	7/1/98	57.25	6050.27		6034.92
B111189	8/3/98	56.96	6050.56		6034.92
B111189	9/3/98	56.43	6051.09		6034.92
B111189	10/1/98	56.34	6051.18		6034.92
B111189	11/2/98	56.08	6051.44		6034.92
B111189	12/7/98	56.29	6051.23		6034.92
B200589	1/12/98	21.18	5948.99		5938.57
B200589	2/3/98	21.24	5948.93		5938.57
B200589	2/3/98	19.24	5950.93		5938.57
B200589	3/4/98	21.32	5948.85		5938.57
B200589	4/10/98	17.13	5953.04		5938.57
B200589	5/8/98	13.28	5956.89		5938.57
B200589	6/5/98	16.71	5953.46		5938.57
B200589	6/16/98	17.50	5952.67		5938.57
B200589	7/8/98	18.86	5951.31		5938.57
B200889	1/12/98	19.16	5918.92		5914.98
B200889	3/4/98	19.35	5918.73		5914.98
B200889	4/13/98	13.50	5924.58		5914.98
B200889	5/8/98	8.03	5930.05		5914.98
B200889	6/5/98	10.79	5927.29		5914.98
B200889	7/8/98	13.44	5924.64		5914.98
B200889	8/3/98	15.07	5923.01		5914.98
B200889	9/3/98	16.07	5922.01		5914.98
B200889	10/5/98	17.17	5920.91		5914.98
B200889	11/2/98	17.83	5920.25		5914.98

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B200889	11/2/98	17.83	5920.25		5914.98
B200889	12/7/98	18.68	5919.40		5914.98
B202589	1/15/98	3.37	5722.08		5713.85
B206989	1/12/98	21.24	5863.08		5863.02
B206989	4/10/98	22.43	5861.89	X	5863.02
B206989	7/1/98	23.07	5861.25	X	5863.02
B206989	10/6/98	22.57	5861.75	X	5863.02
B208089	1/13/98	12.93	5924.14	X	5924.17
B208089	2/5/98	13.06	5924.01	X	5924.17
B208089	3/4/98	13.40	5923.67	X	5924.17
B208089	4/13/98	8.00	5929.07		5924.17
B208089	5/5/98	8.29	5928.78		5924.17
B208089	6/2/98	11.16	5925.91		5924.17
B208089	7/1/98	11.98	5925.09		5924.17
B208089	8/4/98	12.61	5924.46		5924.17
B208089	9/1/98	12.70	5924.37		5924.17
B208089	10/6/98	13.15	5923.92	X	5924.17
B208089	11/3/98	13.48	5923.59	X	5924.17
B208089	12/3/98	13.61	5923.46	X	5924.17
B208189	1/13/98	13.93	5923.53		5911.16
B208289	1/12/98	17.04	5835.91	X	5837.55
B208289	4/7/98	17.11	5835.84	X	5837.55
B208289	7/1/98	17.27	5835.68	X	5837.55
B208289	10/6/98	16.65	5836.30	X	5837.55
B208589	1/12/98	4.00	5854.35		5854.35
B208589	2/18/98	4.05	5854.30	X	5854.35
B208589	3/11/98	4.02	5854.33	X	5854.35
B208589	4/9/98	2.87	5855.48		5854.35
B208589	5/7/98	3.21	5855.14		5854.35
B208589	6/5/98	4.45	5853.90	X	5854.35
B208689	1/12/98	18.27	5851.33		5847.80
B208689	2/18/98	15.75	5853.85		5847.80
B208789	1/13/98	3.14	5905.89		5898.13
B208789	2/19/98	3.33	5905.70		5898.13
B208789	4/7/98	2.60	5906.43		5898.13
B208789	5/8/98	2.52	5906.51		5898.13
B208789	7/1/98	4.65	5904.38		5898.13
B208789	10/6/98	6.37	5902.66		5898.13
B210389	1/12/98	24.75	5850.57	X	5852.22
B210389	2/18/98	23.96	5851.36	X	5852.22
B210389	3/11/98	23.59	5851.73	X	5852.22
B210389	4/9/98	23.08	5852.24		5852.22
B210389	5/6/98	22.67	5852.65		5852.22
B210389	6/5/98	22.11	5853.21		5852.22
B210489	1/12/98	4.13	5854.58		5851.31
B210489	2/18/98	4.17	5854.54		5851.31
B210489	3/11/98	4.15	5854.56		5851.31
B210489	4/7/98	2.80	5855.91		5851.31
B210489	5/5/98	2.83	5855.88		5851.31

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B210489	6/2/98	4.93	5853.78		5851.31
B210489	6/17/98	5.07	5853.64		5851.31
B210489	7/1/98	5.76	5852.95		5851.31
B213789	5/11/98	8.56	5911.45	X	5913.11
B400389	1/5/98	23.07	6100.93		6075.00
B400389	2/4/98	23.74	6100.26		6075.00
B400389	3/2/98	25.28	6098.72		6075.00
B400389	4/1/98	21.85	6102.15		6075.00
B400389	5/4/98	16.37	6107.63		6075.00
B400389	6/1/98	16.75	6107.25		6075.00
B400389	7/1/98	20.05	6103.95		6075.00
B400389	8/3/98	20.23	6103.77		6075.00
B400389	9/1/98	21.22	6102.78		6075.00
B400389	10/5/98	22.41	6101.59		6075.00
B400389	11/3/98	23.33	6100.67		6075.00
B400389	12/1/98	23.89	6100.11		6075.00
B402689	1/5/98	4.16	6042.91	X	6043.77
B402689	2/4/98	3.81	6043.26	X	6043.77
B402689	3/2/98	4.45	6042.62	X	6043.77
B402689	4/1/98	2.90	6044.17		6043.77
B402689	4/7/98	2.98	6044.09		6043.77
B402689	5/4/98	3.11	6043.96		6043.77
B402689	6/1/98	3.90	6043.17	X	6043.77
B402689	7/1/98	5.65	6041.42	X	6043.77
B402689	8/3/98	5.63	6041.44	X	6043.77
B402689	9/1/98	6.24	6040.83	X	6043.77
B402689	10/5/98	6.24	6040.83	X	6043.77
B402689	11/3/98	5.37	6041.70	X	6043.77
B402689	12/1/98	4.27	6042.80	X	6043.77
B410589	1/5/98	54.27	6059.53		6053.80
B410589	2/3/98	54.26	6059.54		6053.80
B410589	3/2/98	54.02	6059.78		6053.80
B410589	4/10/98	54.03	6059.77		6053.80
B410589	5/5/98	52.66	6061.14		6053.80
B410589	6/1/98	51.47	6062.33		6053.80
B410589	7/2/98	50.57	6063.23		6053.80
B410589	8/3/98	51.08	6062.72		6053.80
B410589	9/1/98	50.96	6062.84		6053.80
B410589	10/1/98	51.07	6062.73		6053.80
B410589	11/2/98	51.16	6062.64		6053.80
B410589	12/7/98	51.74	6062.06		6053.80
B410689	1/5/98	44.00	6049.71		6043.61
B410689	4/10/98	43.66	6050.05		6043.61
B410689	10/1/98	40.18	6053.53		6043.61
B410789	1/8/98	37.52	6046.14		6038.66
B410789	4/10/98	37.12	6046.54		6038.66
B410789	10/1/98	34.05	6049.61		6038.66
B411289	1/7/98	63.92	6063.38		6058.90
B411289	2/4/98	63.66	6063.64		6058.90

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B411289	3/2/98	63.66	6063.64		6058.90
B411289	4/10/98	63.59	6063.71		6058.90
B411289	5/5/98	63.16	6064.14		6058.90
B411289	6/1/98	62.73	6064.57		6058.90
B411289	7/1/98	62.13	6065.17		6058.90
B411289	8/3/98	61.65	6065.65		6058.90
B411289	9/3/98	60.95	6066.35		6058.90
B411289	10/1/98	60.81	6066.49		6058.90
B411289	11/2/98	60.43	6066.87		6058.90
B411289	12/7/98	60.35	6066.95		6058.90
B411389	2/3/98	55.63	6055.43		6047.56
P114389	1/6/98	6.88	5986.29		5978.67
P114389	2/5/98	6.75	5986.42		5978.67
P114389	3/5/98	7.30	5985.87		5978.67
P114389	4/7/98	5.96	5987.21		5978.67
P114389	5/5/98	6.00	5987.17		5978.67
P114389	6/3/98	6.67	5986.50		5978.67
P114389	7/1/98	7.28	5985.89		5978.67
P114389	8/4/98	7.22	5985.95		5978.67
P114389	9/8/98	7.60	5985.57		5978.67
P114389	10/5/98	7.78	5985.39		5978.67
P114389	11/5/98	7.33	5985.84		5978.67
P114389	12/2/98	7.51	5985.66		5978.67
P114489	1/13/98	12.73	6022.70		5986.63
P114489	4/8/98	8.35	6027.08		5986.63
P114489	10/5/98	14.03	6021.40		5986.63
P114589	1/13/98	5.06	6020.84		5989.40
P114589	4/8/98	2.62	6023.28		5989.40
P114589	10/5/98	7.20	6018.70		5989.40
P114689	1/7/98	10.51	5995.25		5983.56
P114689	4/8/98	7.88	5997.88		5983.56
P114689	9/17/98	12.53	5993.23		5983.56
P114689	10/5/98	13.34	5992.42		5983.56
P114789	1/7/98	9.66	6002.74		5986.20
P114789	4/8/98	7.91	6004.49		5986.20
P114789	9/17/98	10.08	6002.32		5986.20
P114789	10/5/98	10.22	6002.18		5986.20
P114889	1/7/98	7.10	6011.16		6003.96
P114889	3/11/98	7.14	6011.12		6003.96
P114889	4/8/98	6.42	6011.84		6003.96
P114889	5/5/98	6.15	6012.11		6003.96
P114889	6/3/98	4.78	6013.48		6003.96
P114889	6/18/98	4.78	6013.48		6003.96
P114889	7/8/98	4.93	6013.33		6003.96
P114889	9/17/98	5.33	6012.93		6003.96
P114989	1/6/98	13.36	6018.48		5993.84
P114989	4/8/98	14.47	6017.37		5993.84
P114989	9/17/98	12.50	6019.34		5993.84
P114989	10/5/98	12.53	6019.31		5993.84

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P115089	1/6/98	13.95	6026.15		5999.40
P115089	2/5/98	13.90	6026.20		5999.40
P115089	3/2/98	14.80	6025.30		5999.40
P115089	4/8/98	9.94	6030.16		5999.40
P115089	5/5/98	8.63	6031.47		5999.40
P115089	6/3/98	10.63	6029.47		5999.40
P115089	7/8/98	12.73	6027.37		5999.40
P115089	8/4/98	13.36	6026.74		5999.40
P115089	9/8/98	14.24	6025.86		5999.40
P115089	9/17/98	14.68	6025.42		5999.40
P115089	10/5/98	15.32	6024.78		5999.40
P115089	11/5/98	16.31	6023.79		5999.40
P115089	12/2/98	16.12	6023.98		5999.40
P115489	1/16/98	9.49	6015.61		5998.60
P115489	3/11/98	10.35	6014.75		5998.60
P115489	4/8/98	7.15	6017.95		5998.60
P115489	5/5/98	6.62	6018.48		5998.60
P115489	6/3/98	7.59	6017.51		5998.60
P115489	6/18/98	7.98	6017.12		5998.60
P115489	7/8/98	8.74	6016.36		5998.60
P115489	9/17/98	10.10	6015.00		5998.60
P115489	9/17/98	10.10	6015.00		5998.60
P115589	1/7/98	6.48	6009.29		5986.27
P115589	4/8/98	4.20	6011.57		5986.27
P115589	9/17/98	7.67	6008.10		5986.27
P115589	10/5/98	8.21	6007.56		5986.27
P115689	1/7/98	10.40	5998.31		5988.51
P115689	4/8/98	5.82	6002.89		5988.51
P115689	9/17/98	12.56	5996.15		5988.51
P115689	10/5/98	12.80	5995.91		5988.51
P119389	1/7/98	4.24	6008.94		5996.28
P119389	2/5/98	4.50	6008.68		5996.28
P119389	3/3/98	4.99	6008.19		5996.28
P119389	4/2/98	4.95	6008.23		5996.28
P119389	5/6/98	5.64	6007.54		5996.28
P119389	6/2/98	4.81	6008.37		5996.28
P119389	6/17/98	4.04	6009.14		5996.28
P119389	7/7/98	4.91	6008.27		5996.28
P207389	1/12/98	6.76	5976.01		5967.57
P207689	1/7/98	8.03	5959.85		5954.78
P207689	4/2/98	5.80	5962.08		5954.78
P207689	10/7/98	10.62	5957.26		5954.78
P207789	1/7/98	25.71	5942.04		5940.45
P207889	1/6/98	6.12	5958.78		5957.20
P207889	2/11/98	5.97	5958.93		5957.20
P207889	4/2/98	3.93	5960.97		5957.20
P207889	10/7/98	10.11	5954.79	X	5957.20
P207989	1/6/98	20.64	5944.53	X	5944.67
P207989	2/10/98	25.34	5939.83	X	5944.67

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P207989	2/11/98	18.85	5946.32		5944.67
P208889	2/11/98	93.08	5856.17		5852.35
P208989	2/11/98	17.41	5947.15		5939.76
P208989	3/11/98	17.52	5947.04		5939.76
P208989	4/8/98	13.00	5951.56		5939.76
P208989	5/6/98	12.00	5952.56		5939.76
P208989	6/4/98	14.34	5950.22		5939.76
P209089	2/11/98	24.55	5949.70		5948.25
P209189	2/16/98	13.51	5968.70		5947.21
P209289	1/6/98	14.73	5968.69	X	5970.72
P209289	4/2/98	13.63	5969.79	X	5970.72
P209289	7/7/98	15.04	5968.38	X	5970.72
P209289	10/7/98	14.75	5968.67	X	5970.72
P209389	1/12/98	19.07	5964.32		5954.59
P209389	4/2/98	16.88	5966.51		5954.59
P209389	7/7/98	18.46	5964.93		5954.59
P209389	10/7/98	18.96	5964.43		5954.59
P209489	2/16/98	29.27	5950.83		5945.10
P209489	4/8/98	27.05	5953.05		5945.10
P209489	7/7/98	28.73	5951.37		5945.10
P209489	10/7/98	29.26	5950.84		5945.10
P209589	2/11/98	20.17	5929.87	X	5931.54
P209689	1/7/98	24.68	5939.75		5937.73
P209789	1/7/98	8.72	5956.22		5952.44
P209789	2/10/98	8.81	5956.13		5952.44
P209789	4/2/98	4.34	5960.60		5952.44
P209789	10/7/98	11.81	5953.13		5952.44
P209889	2/11/98	5.65	5936.75		5924.10
P209889	6/17/98	4.93	5937.47		5924.10
P209889	7/7/98	5.39	5937.01		5924.10
P209889	7/7/98	5.39	5937.01		5924.10
P210089	1/13/98	20.40	5880.00		5878.90
P210089	2/19/98	19.23	5881.17		5878.90
P210089	3/11/98	18.90	5881.50		5878.90
P210089	4/9/98	15.81	5884.59		5878.90
P210089	5/6/98	11.91	5888.49		5878.90
P210089	6/5/98	18.51	5881.89		5878.90
P210189	2/16/98	14.50	5967.98		5946.38
P213689	1/13/98	9.42	5986.62		5982.54
P213689	3/11/98	9.78	5986.26		5982.54
P213689	4/8/98	8.69	5987.35		5982.54
P213689	5/7/98	8.17	5987.87		5982.54
P213689	6/3/98	7.66	5988.38		5982.54
P213689	6/18/98	8.08	5987.96		5982.54
P213689	7/8/98	8.73	5987.31		5982.54
P213989	1/13/98			DRY	5949.48
P215789	1/13/98	9.23	5994.43		5985.16
P215789	4/8/98	14.23	5989.43		5985.16
P215789	10/5/98	16.46	5987.20		5985.16

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P218089	1/7/98	5.55	5982.00		5980.15
P218089	4/2/98	4.12	5983.43		5980.15
P218089	10/7/98	5.85	5981.70		5980.15
P218289	1/6/98	9.42	6008.78		5994.70
P218289	4/8/98	4.98	6013.22		5994.70
P218289	9/17/98	9.92	6008.28		5994.70
P218289	10/6/98	10.46	6007.74		5994.70
P218389	1/7/98	14.44	5944.01	X	5945.95
P218389	2/5/98	14.75	5943.70	X	5945.95
P218389	2/16/98	14.80	5943.65	X	5945.95
P218389	3/3/98	14.80	5943.65	X	5945.95
P218389	3/11/98	14.84	5943.61	X	5945.95
P218389	4/2/98	8.65	5949.80		5945.95
P218389	5/6/98	7.24	5951.21		5945.95
P218389	6/4/98	10.17	5948.28		5945.95
P218389	7/7/98	12.77	5945.68	X	5945.95
P218389	8/5/98	10.18	5948.27		5945.95
P218389	9/2/98	14.32	5944.13	X	5945.95
P218389	10/7/98	14.77	5943.68	X	5945.95
P218389	11/2/98	14.84	5943.61	X	5945.95
P218389	12/1/98			DRY	5945.95
P219189	1/5/98	12.40	5930.75	X	5931.65
P219189	2/5/98	13.45	5929.70	X	5931.65
P219189	3/3/98	13.14	5930.01	X	5931.65
P219189	4/8/98	12.66	5930.49	X	5931.65
P219189	5/6/98	11.87	5931.28	X	5931.65
P219189	6/2/98	11.41	5931.74		5931.65
P219189	7/7/98	13.47	5929.68	X	5931.65
P219189	8/5/98	13.04	5930.11	X	5931.65
P219189	9/2/98	12.58	5930.57	X	5931.65
P219189	10/7/98	12.01	5931.14	X	5931.65
P219189	11/2/98	12.00	5931.15	X	5931.65
P219189	12/1/98	13.42	5929.73	X	5931.65
P219489	1/6/98	23.35	5937.80	X	5938.25
P219489	4/2/98	23.74	5937.41	X	5938.25
P219489	7/7/98	24.42	5936.73	X	5938.25
P219489	10/7/98	22.93	5938.22	X	5938.25
P219589	2/16/98	27.43	5938.27	X	5940.00
P219589	3/11/98	27.28	5938.42	X	5940.00
P219589	4/8/98	27.00	5938.70	X	5940.00
P219589	5/6/98	26.64	5939.06	X	5940.00
P219589	6/5/98	26.28	5939.42	X	5940.00
P313489	1/6/98	14.69	5998.89		5992.48
P313489	4/8/98	9.26	6004.32		5992.48
P313489	9/17/98	15.53	5998.05		5992.48
P313489	10/6/98	15.89	5997.69		5992.48
P313589	1/6/98	9.39	6000.72		5997.61
P313589	2/5/98	9.55	6000.56		5997.61
P313589	3/5/98	10.15	5999.96		5997.61

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P313589	4/2/98	7.14	6002.97		5997.61
P313589	5/5/98	7.52	6002.59		5997.61
P313589	6/3/98	8.04	6002.07		5997.61
P313589	7/8/98	8.45	6001.66		5997.61
P313589	8/4/98	8.08	6002.03		5997.61
P313589	9/8/98	8.55	6001.56		5997.61
P313589	10/6/98	8.94	6001.17		5997.61
P313589	11/5/98	9.34	6000.77		5997.61
P313589	12/1/98	9.41	6000.70		5997.61
P314289	1/6/98	13.45	5998.32		5998.27
P314289	2/5/98	13.89	5997.88	X	5998.27
P314289	3/5/98	16.41	5995.36	X	5998.27
P314289	4/2/98	15.03	5996.74	X	5998.27
P314289	5/5/98	13.19	5998.58		5998.27
P314289	6/3/98	12.69	5999.08		5998.27
P314289	7/8/98	12.95	5998.82		5998.27
P314289	8/4/98	14.29	5997.48	X	5998.27
P314289	9/8/98	12.77	5999.00		5998.27
P314289	9/17/98	12.81	5998.96		5998.27
P314289	10/6/98	12.86	5998.91		5998.27
P314289	11/4/98	13.43	5998.34		5998.27
P314289	12/1/98	13.78	5997.99	X	5998.27
P317989	1/7/98	6.42	5986.42		5985.34
P317989	4/7/98	3.62	5989.22		5985.34
P317989	10/6/98	7.84	5985.00	X	5985.34
P320089	1/6/98	14.41	5997.46		5993.07
P320089	4/8/98	9.99	6001.88		5993.07
P320089	9/17/98	15.20	5996.67		5993.07
P320089	10/5/98	15.50	5996.37		5993.07
P414189	1/6/98	8.81	6003.37		5993.68
P414189	4/8/98	5.09	6007.09		5993.68
P414189	9/17/98	11.09	6001.09		5993.68
P414189	10/6/98	12.15	6000.03		5993.68
P415889	1/6/98	13.23	6039.37		6009.40
P415889	2/5/98	13.33	6039.27		6009.40
P415889	3/5/98	15.15	6037.45		6009.40
P415889	4/8/98	10.63	6041.97		6009.40
P415889	5/5/98	9.64	6042.96		6009.40
P415889	6/3/98	10.90	6041.70		6009.40
P415889	6/16/98	11.21	6041.39		6009.40
P415889	7/8/98	13.09	6039.51		6009.40
P415889	9/17/98	15.56	6037.04		6009.40
P415989	1/6/98	5.56	6041.15		6020.01
P415989	4/8/98	2.94	6043.77		6020.01
P415989	9/17/98	8.45	6038.26		6020.01
P415989	10/5/98	9.61	6037.10		6020.01
P416089	1/6/98	6.48	6047.47		6019.95
P416089	2/5/98	3.60	6050.35		6019.95
P416089	3/5/98	10.23	6043.72		6019.95

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P416089	4/8/98	3.84	6050.11		6019.95
P416089	5/5/98	3.86	6050.09		6019.95
P416089	6/3/98	5.45	6048.50		6019.95
P416089	7/8/98	8.86	6045.09		6019.95
P416089	8/4/98	7.76	6046.19		6019.95
P416089	9/8/98	10.73	6043.22		6019.95
P416089	9/17/98	11.53	6042.42		6019.95
P416089	10/5/98	12.42	6041.53		6019.95
P416089	11/4/98	14.03	6039.92		6019.95
P416089	12/1/98	11.88	6042.07		6019.95
P416189	1/6/98	7.90	6040.05		6018.25
P416189	4/8/98	5.22	6042.73		6018.25
P416189	9/17/98	11.66	6036.29		6018.25
P416189	10/5/98	13.18	6034.77		6018.25
P416289	1/6/98	13.44	6026.78		6016.72
P416289	4/2/98	11.64	6028.58		6016.72
P416289	9/17/98	15.07	6025.15		6016.72
P416289	10/5/98	15.98	6024.24		6016.72
P416389	1/6/98	13.23	6043.91		6027.04
P416389	4/8/98	5.15	6051.99		6027.04
P416389	9/17/98	16.67	6040.47		6027.04
P416389	10/5/98	18.00	6039.14		6027.04
P416489	1/6/98	14.57	6035.58		6024.45
P416489	2/5/98	14.82	6035.33		6024.45
P416489	3/5/98	17.54	6032.61		6024.45
P416489	4/8/98	9.22	6040.93		6024.45
P416489	5/5/98	8.52	6041.63		6024.45
P416489	6/3/98	11.91	6038.24		6024.45
P416489	7/8/98	16.60	6033.55		6024.45
P416489	8/4/98	17.65	6032.50		6024.45
P416489	9/3/98	18.41	6031.74		6024.45
P416489	9/17/98	19.37	6030.78		6024.45
P416489	10/5/98	20.44	6029.71		6024.45
P416489	11/4/98	22.10	6028.05		6024.45
P416489	12/1/98	20.20	6029.95		6024.45
P416589	1/6/98	26.04	6016.77		6011.81
P416589	3/12/98	27.46	6015.35		6011.81
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P416589	5/5/98	21.50	6021.31		6011.81
P416589	6/3/98	23.80	6019.01		6011.81
P416589	6/16/98	24.64	6018.17		6011.81
P416589	7/8/98	26.40	6016.41		6011.81
P416589	9/17/98	27.53	6015.28		6011.81
P416689	1/6/98	29.06	6007.49		6004.05
P416689	2/5/98	29.16	6007.39		6004.05
P416689	3/5/98	29.57	6006.98		6004.05
P416689	4/2/98	18.44	6018.11		6004.05
P416689	5/5/98	27.87	6008.68		6004.05
P416689	6/3/98	28.06	6008.49		6004.05

~~236~~ 255

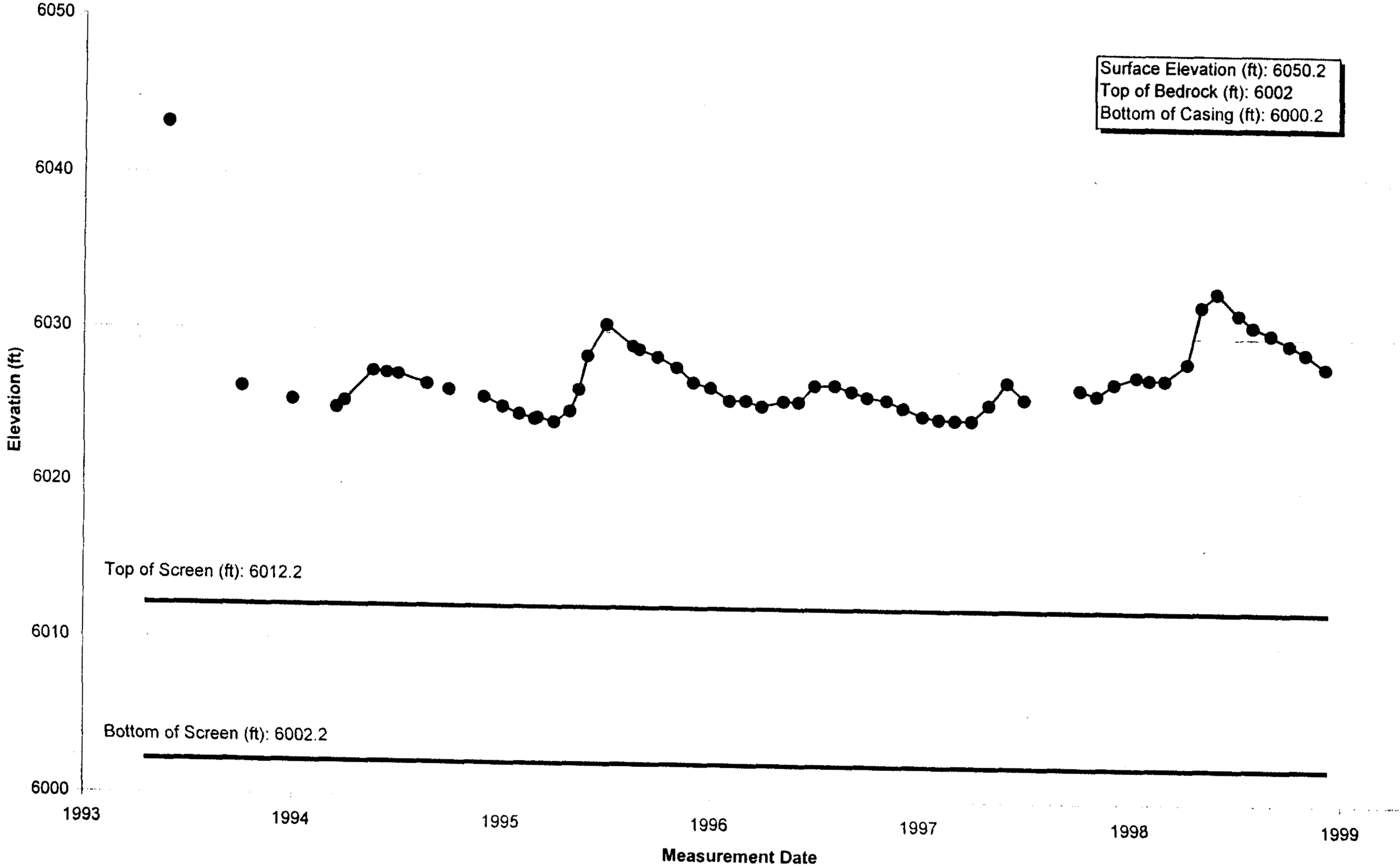
P416689	7/8/98	29.03	6007.52		6004.05
P416689	8/4/98	29.12	6007.43		6004.05
P416689	9/3/98	29.18	6007.37		6004.05
P416689	9/17/98	29.36	6007.19		6004.05
P416689	10/5/98	29.52	6007.03		6004.05
P416689	11/4/98	32.86	6003.69	X	6004.05
P416689	12/1/98	30.31	6006.24		6004.05
P416789	1/6/98	27.07	6002.20	X	6002.37
P416789	2/5/98	27.21	6002.06	X	6002.37
P416789	3/5/98	27.62	6001.65	X	6002.37
P416789	4/2/98	23.54	6005.73		6002.37
P416789	5/5/98	23.43	6005.84		6002.37
P416789	6/3/98	25.56	6003.71		6002.37
P416789	7/8/98	26.91	6002.36	X	6002.37
P416789	8/4/98	26.65	6002.62		6002.37
P416789	9/8/98	27.36	6001.91	X	6002.37
P416789	9/17/98	27.51	6001.76	X	6002.37
P416789	10/5/98	27.69	6001.58	X	6002.37
P416789	11/4/98	29.67	5999.60	X	6002.37
P416789	12/1/98	27.21	6002.06	X	6002.37
P416889	1/6/98	17.86	6000.93		5998.49
P416889	2/5/98	18.00	6000.79		5998.49
P416889	3/5/98	18.47	6000.32		5998.49
P416889	4/2/98	14.60	6004.19		5998.49
P416889	5/5/98	14.12	6004.67		5998.49
P416889	6/3/98	16.48	6002.31		5998.49
P416889	7/8/98	17.76	6001.03		5998.49
P416889	8/4/98	17.46	6001.33		5998.49
P416889	9/8/98	18.35	6000.44		5998.49
P416889	10/5/98	18.62	6000.17		5998.49
P416889	11/4/98	18.66	6000.13		5998.49
P416889	12/1/98	18.11	6000.68		5998.49
P416989	1/7/98	39.39	6008.16		5891.95
P416989	4/8/98	39.11	6008.44		5891.95
P416989	10/5/98	39.15	6008.40		5891.95
P419689	1/6/98	19.20	6004.22		5999.92
P419689	4/8/98	13.89	6009.53		5999.92
P419689	9/17/98	19.65	6003.77		5999.92
P419689	10/5/98	20.14	6003.28		5999.92
TH19	1/12/98	39.79	6006.78		5967.57
TH19	2/4/98	39.90	6006.67		5967.57
TH19	3/4/98	40.40	6006.17		5967.57
TH21	1/12/98	35.77	6003.59		5960.36
TH21	2/4/98	35.95	6003.41		5960.36
TH21	3/4/98	36.35	6003.01		5960.36
TH-21	5/8/98	25.36	6014.00		5960.36

257 256

Appendix B

Well Hydrographs

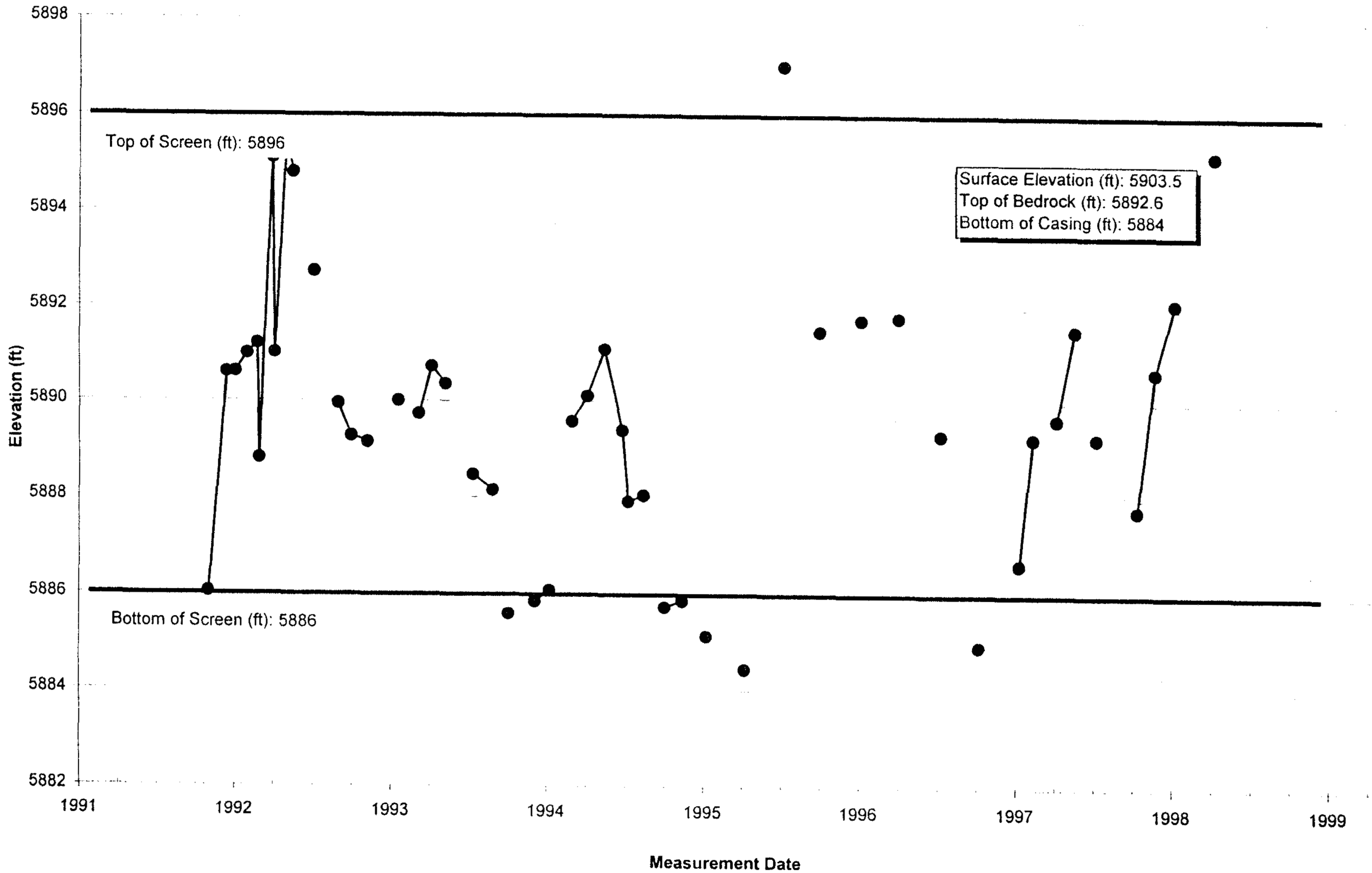
Hydrograph 00293



S1_97[illegible]93 9/22/99

257 258

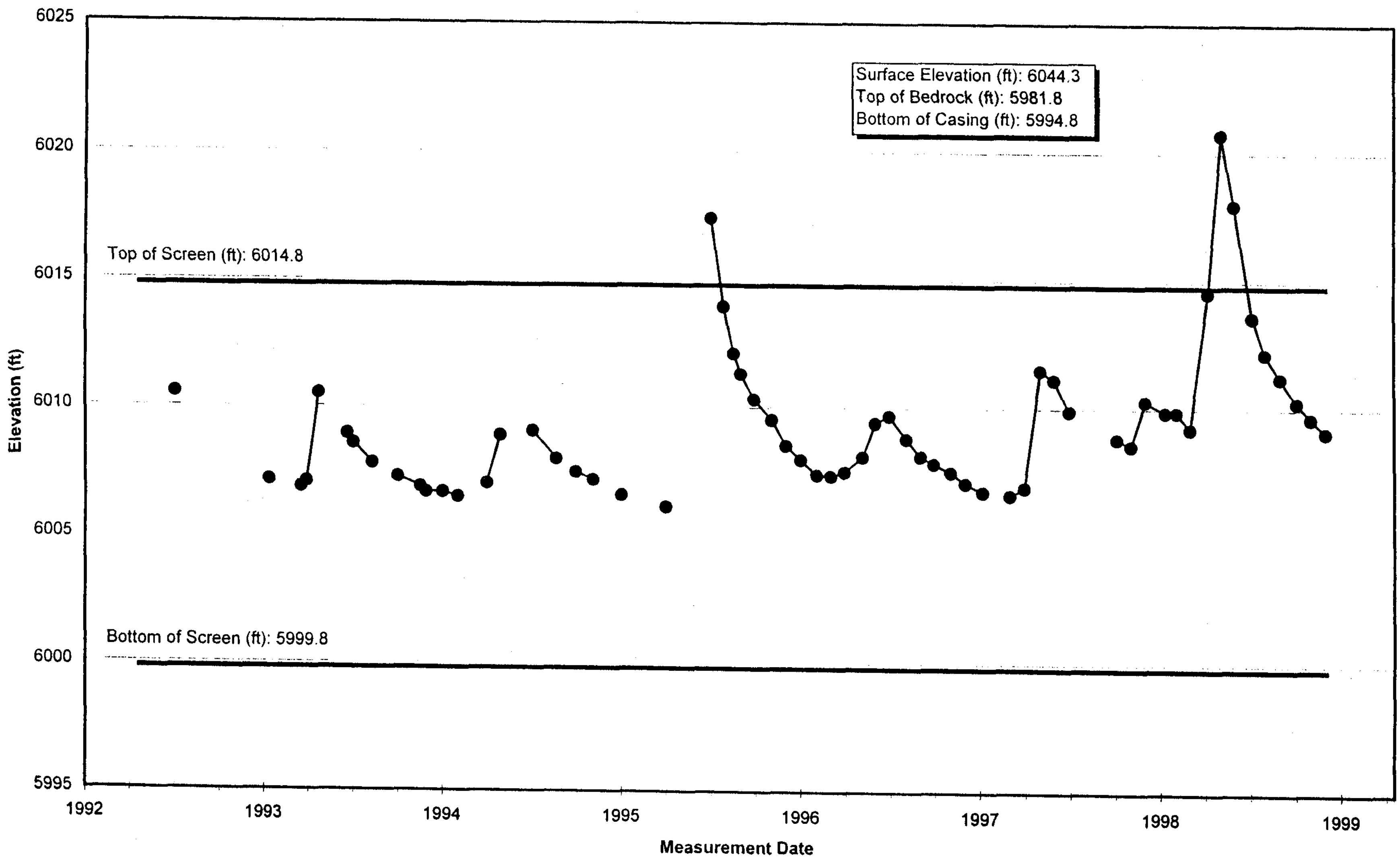
Hydrograph 00491



S1_97.xls 00491 9/22/99

260 259

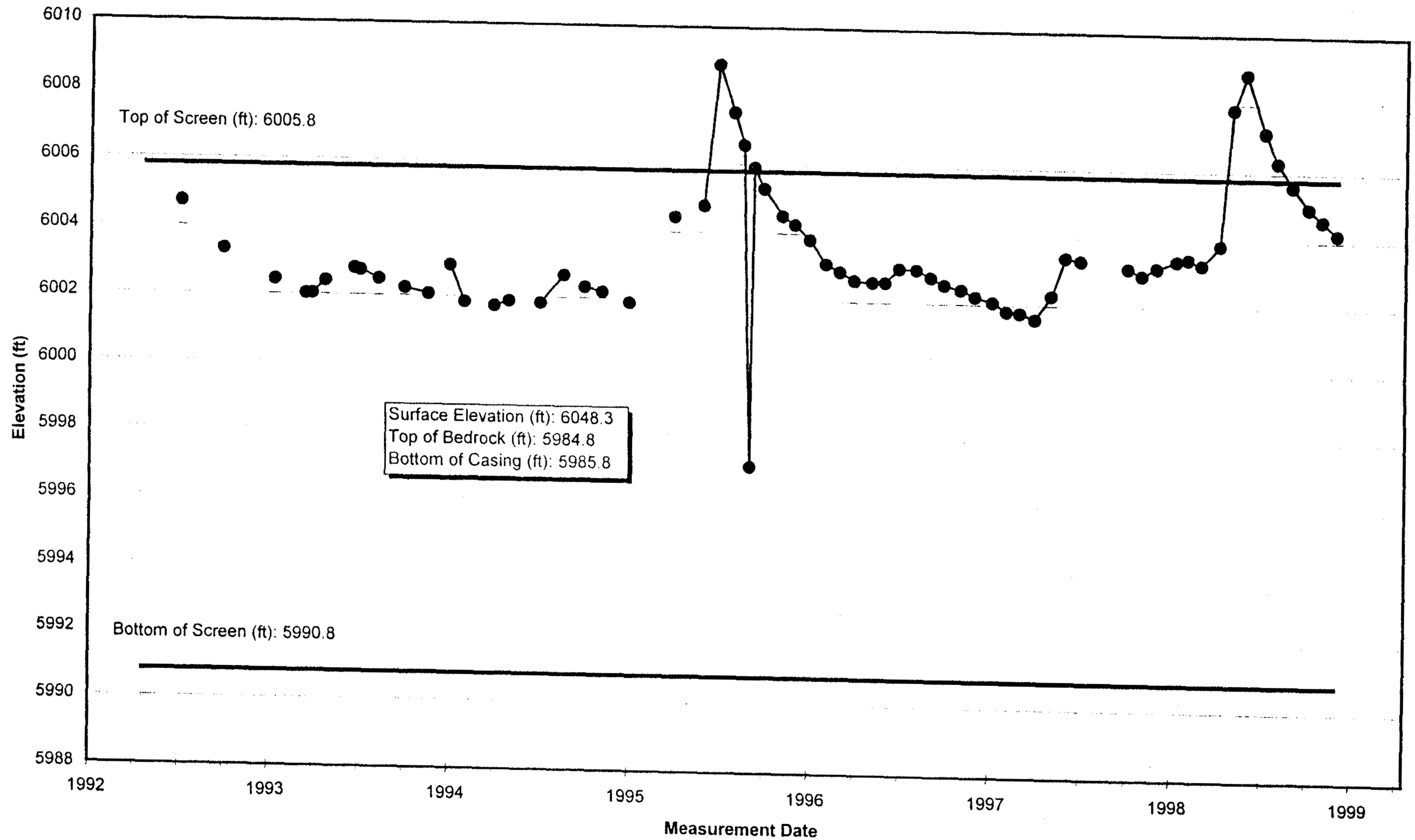
Hydrograph 0190



S1_97 0 9/22/99

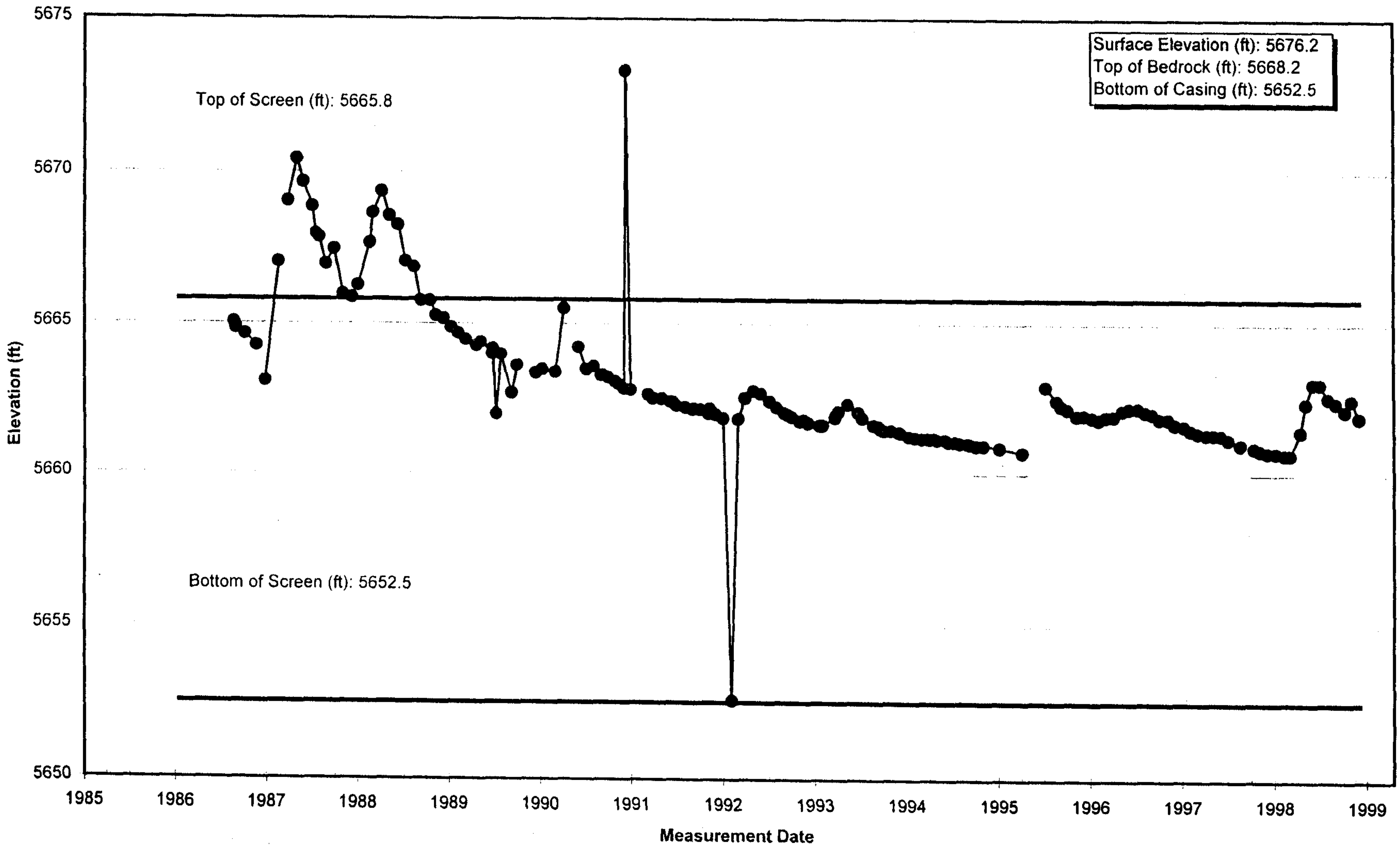
264 260

Hydrograph 0290



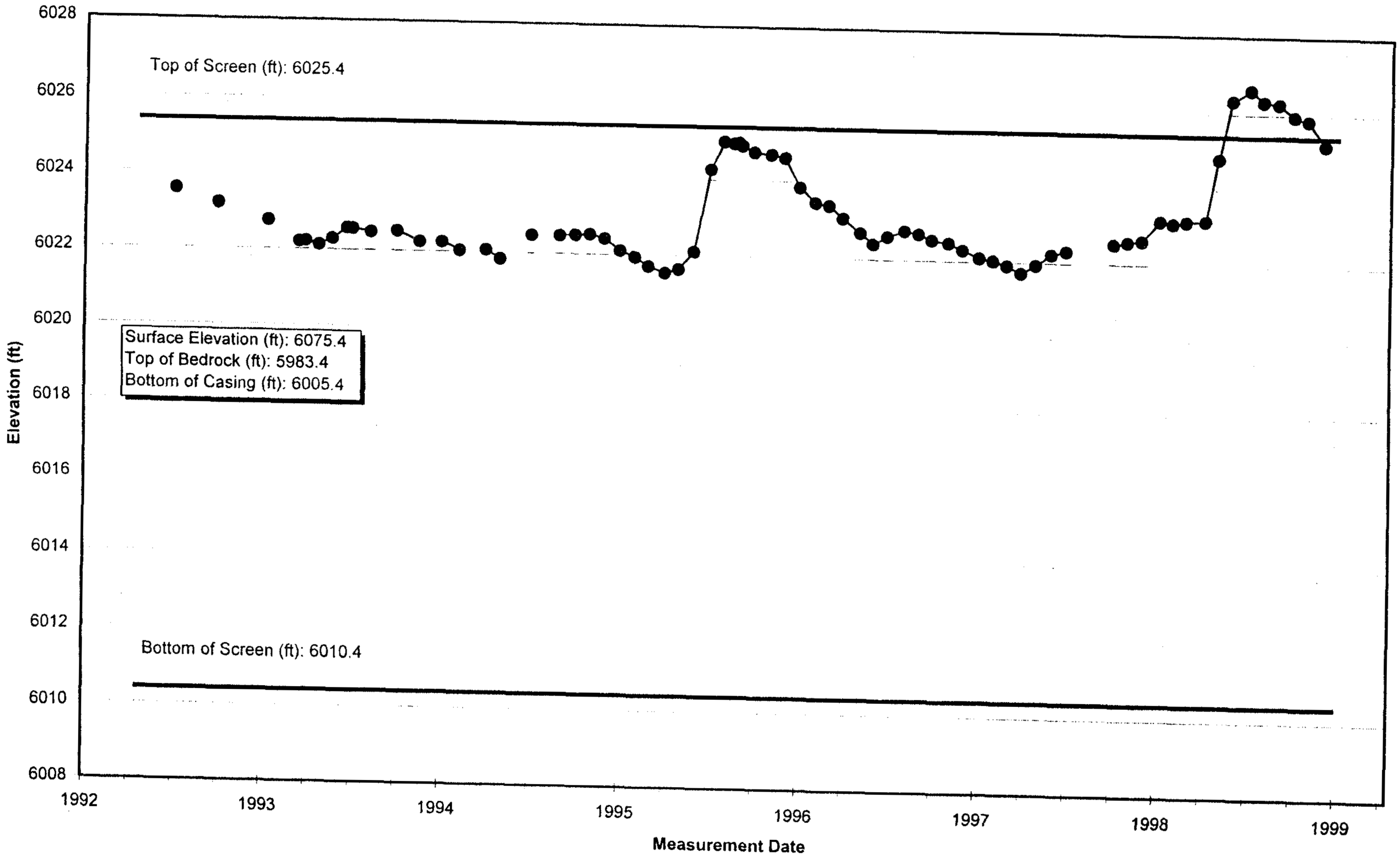
S2_1.xls 0290 9/22/99

Hydrograph 0386



263 2102

Hydrograph 0390



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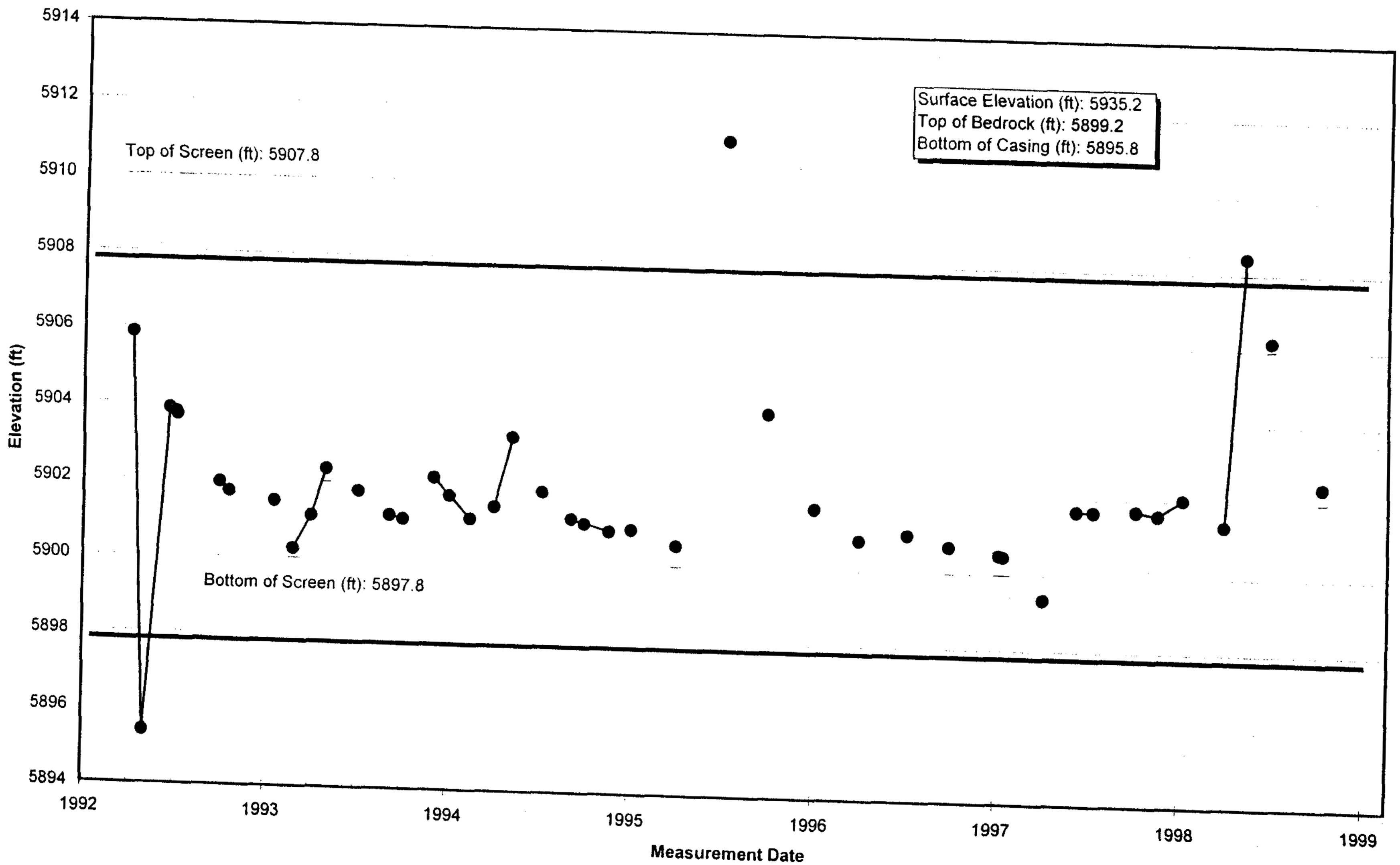
269 263

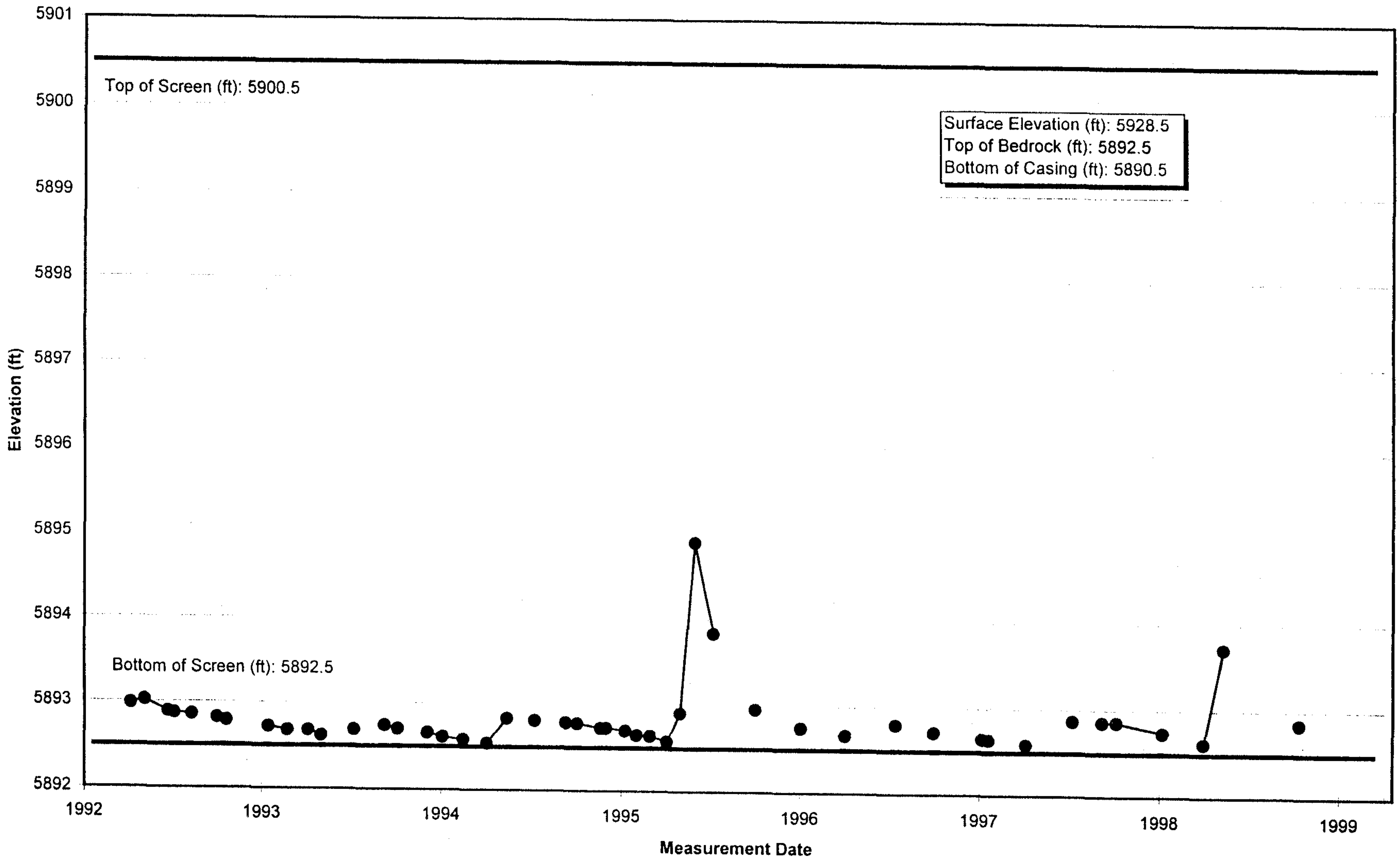
Hydrograph 03991



S2_1.xl 9/22/99

268 264

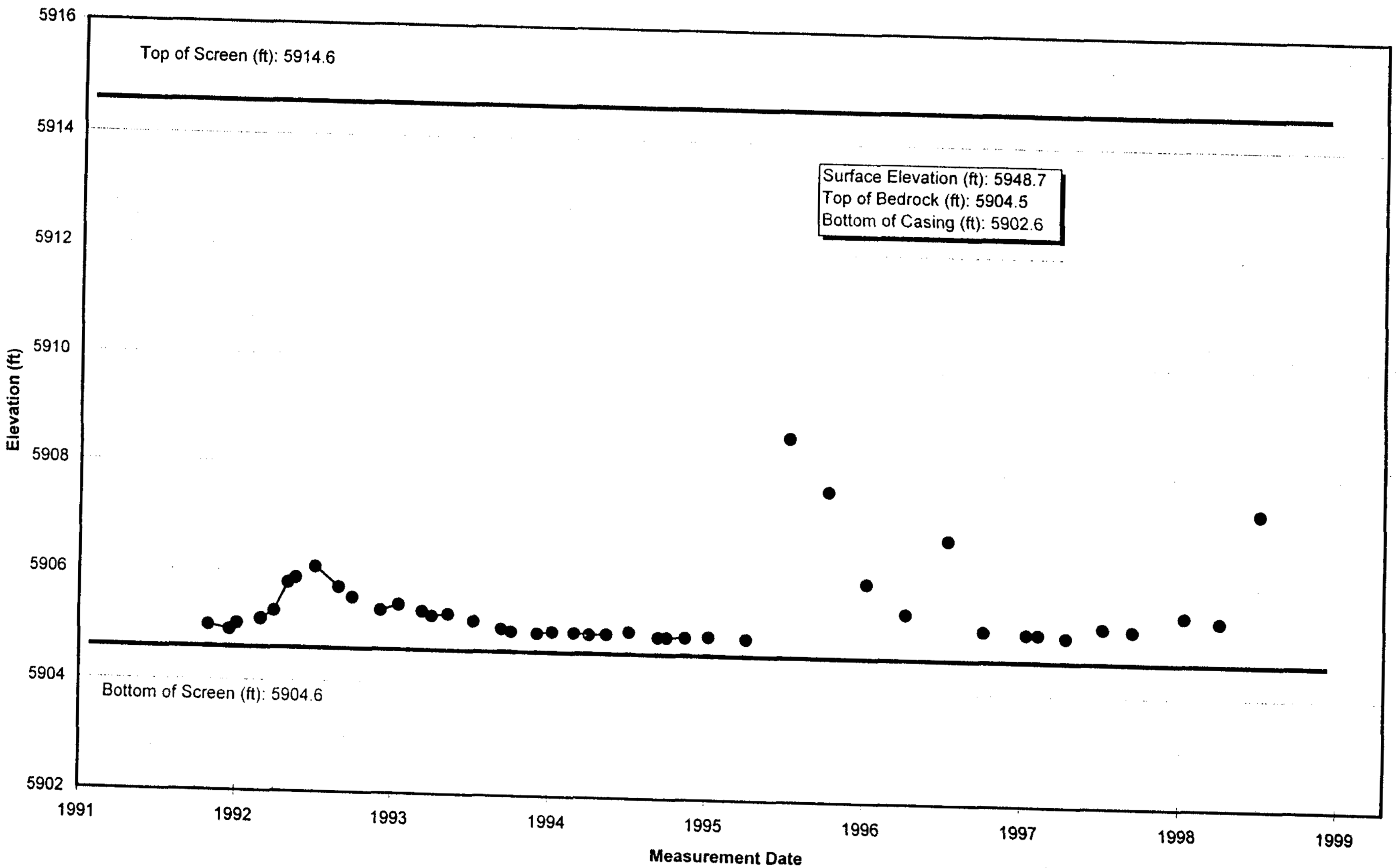
Hydrograph 04091



S2_1.xls 04091 9/22/99

266 265

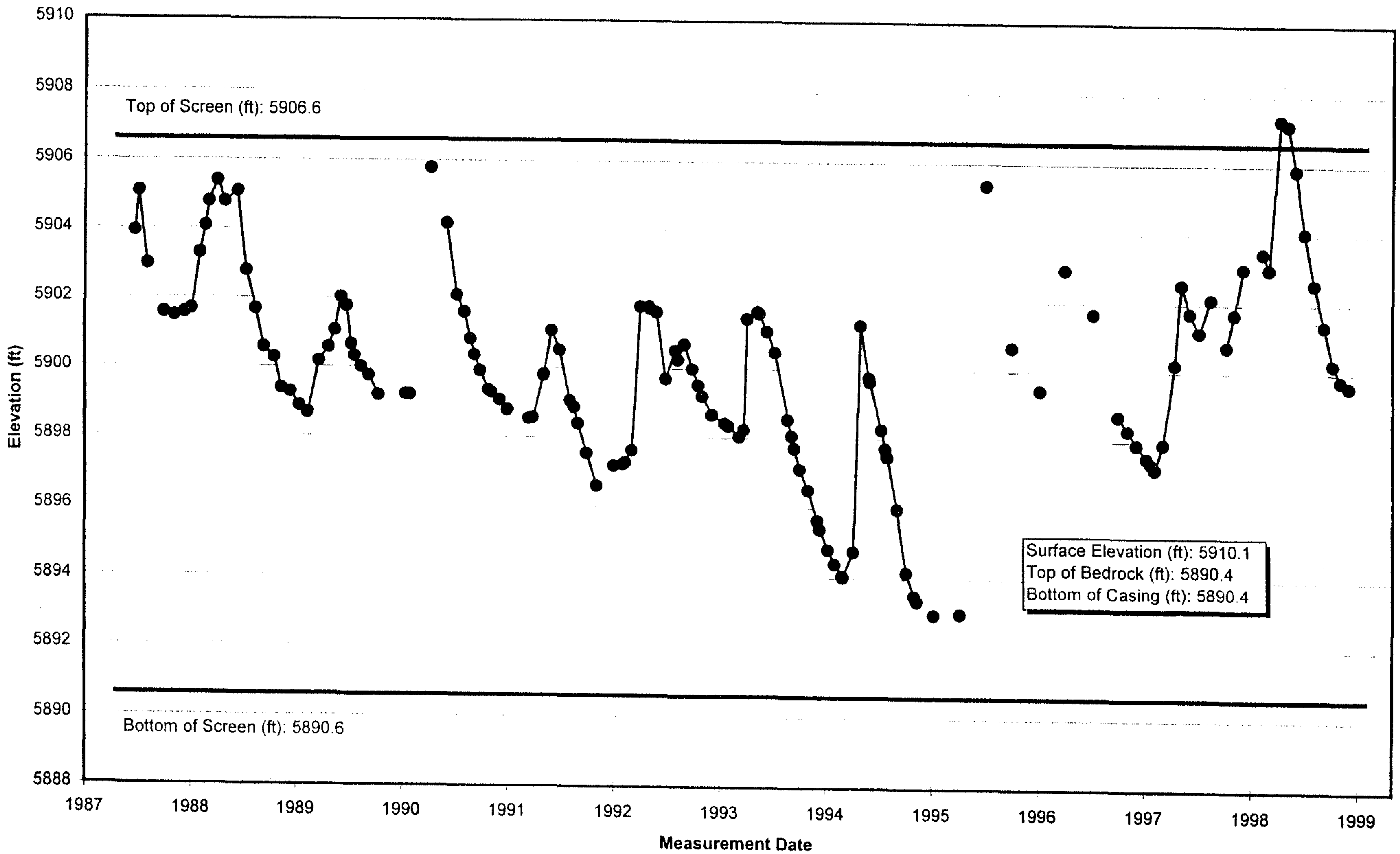
Hydrograph 04591



S3_97 91 9/22/99

269 266

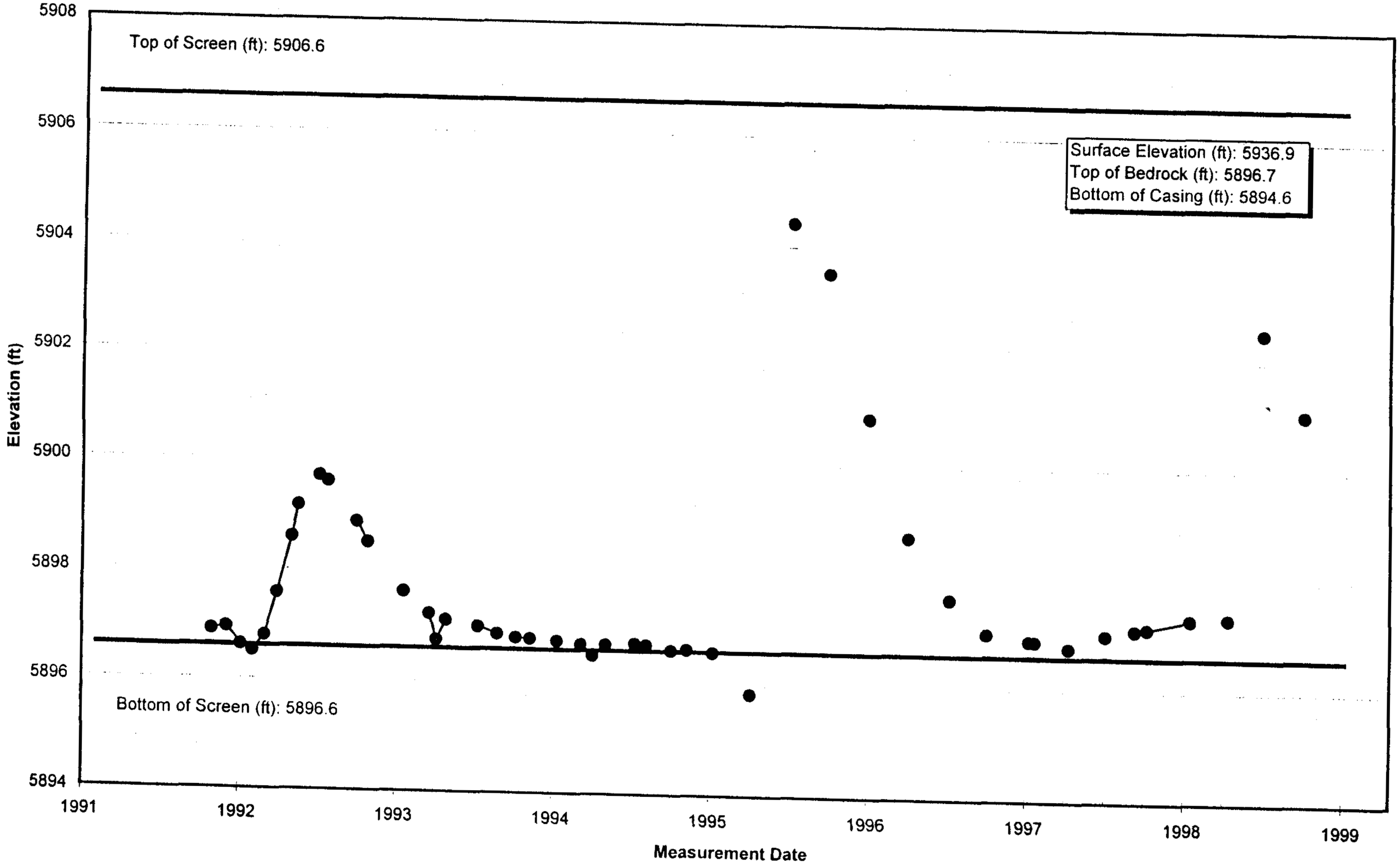
Hydrograph 0487



S3_97.xls 0487 9/22/99

~~248~~ 267

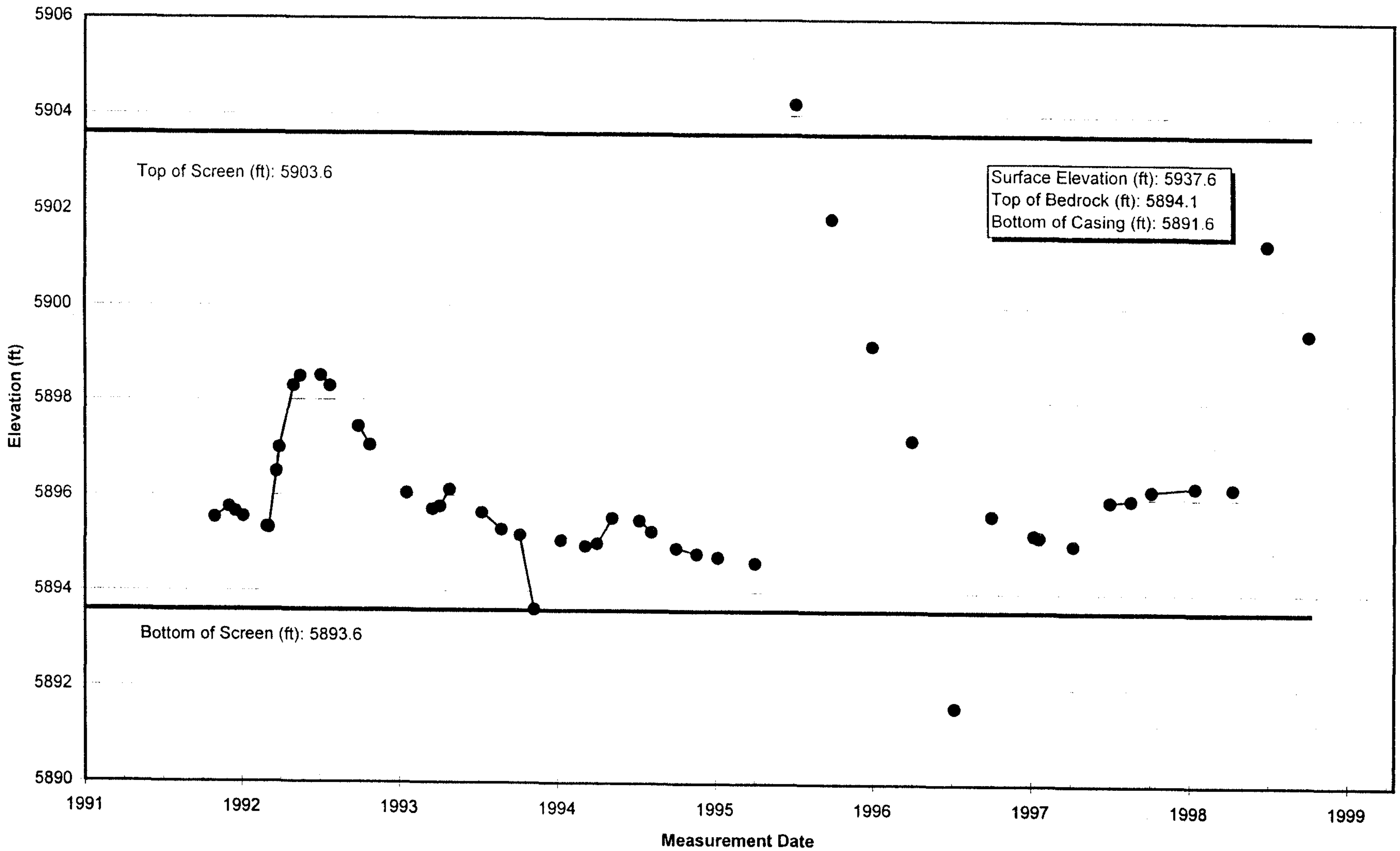
Hydrograph 04991



S3_97 91 9/22/99

~~269~~ 268

Hydrograph 05091



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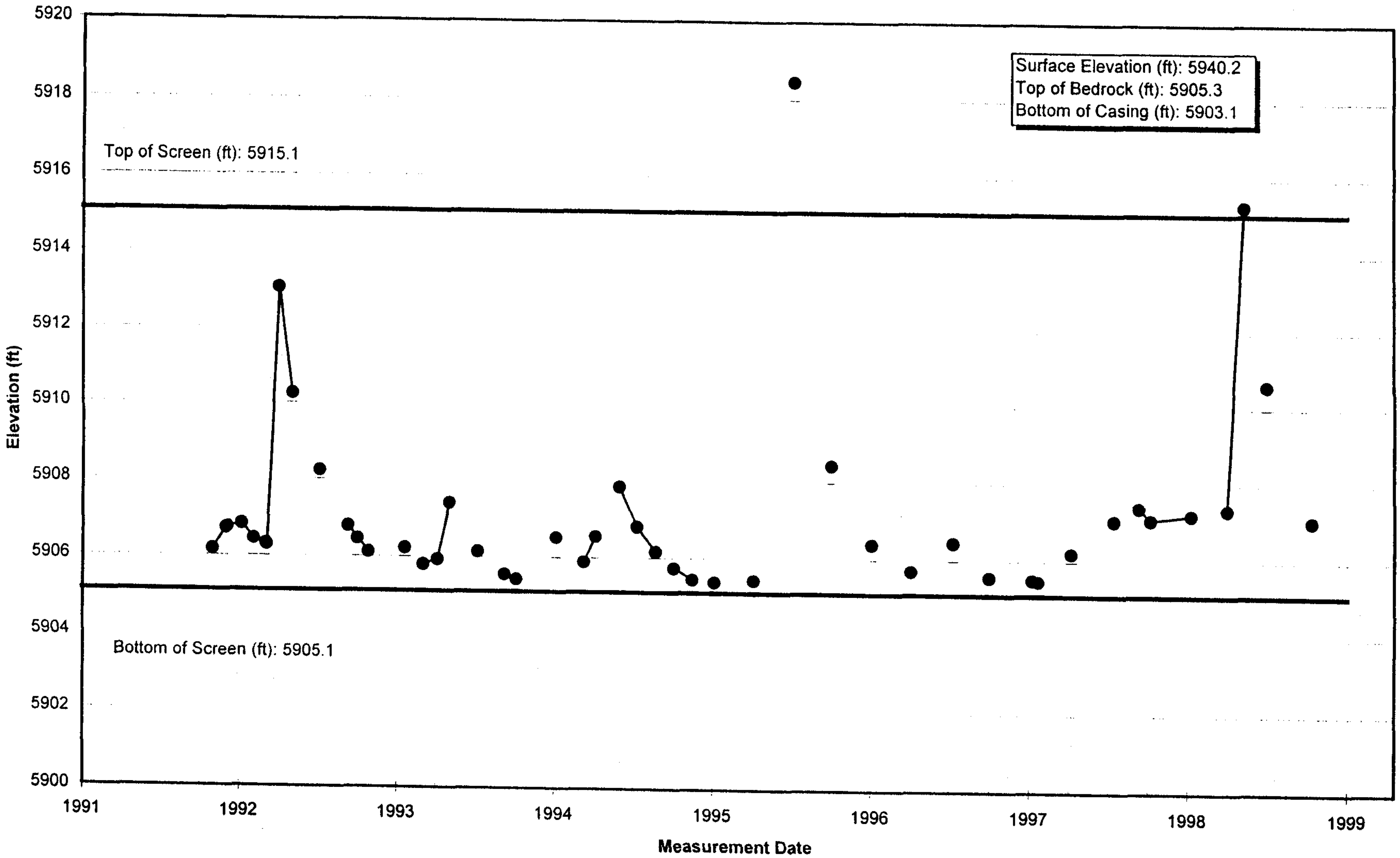
270269

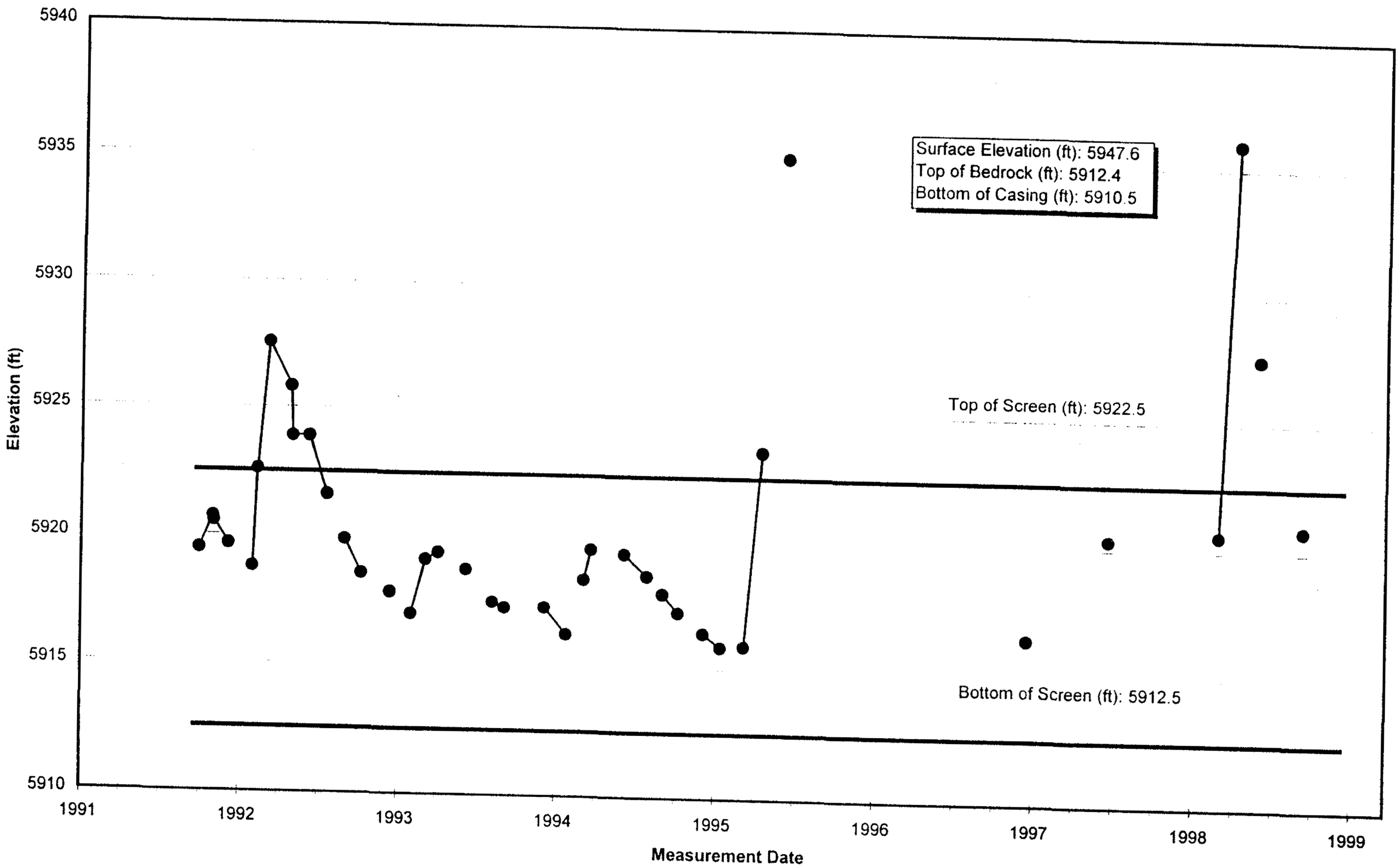
Hydrograph 05391



S3_97 ... 91 9/22/99

27 270

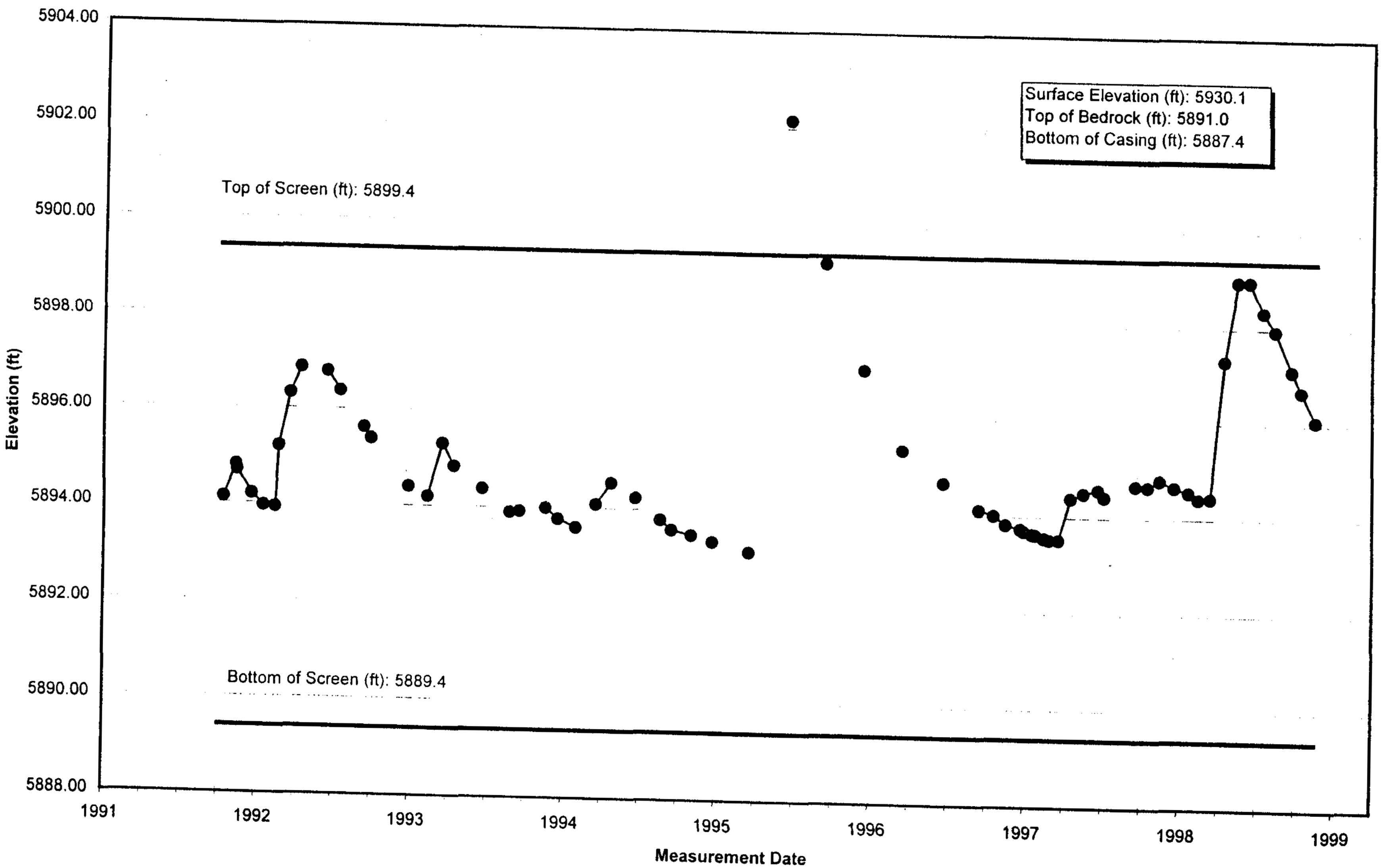
Hydrograph 05691



S3_97.xls 05691 9/22/99

~~272~~ 271

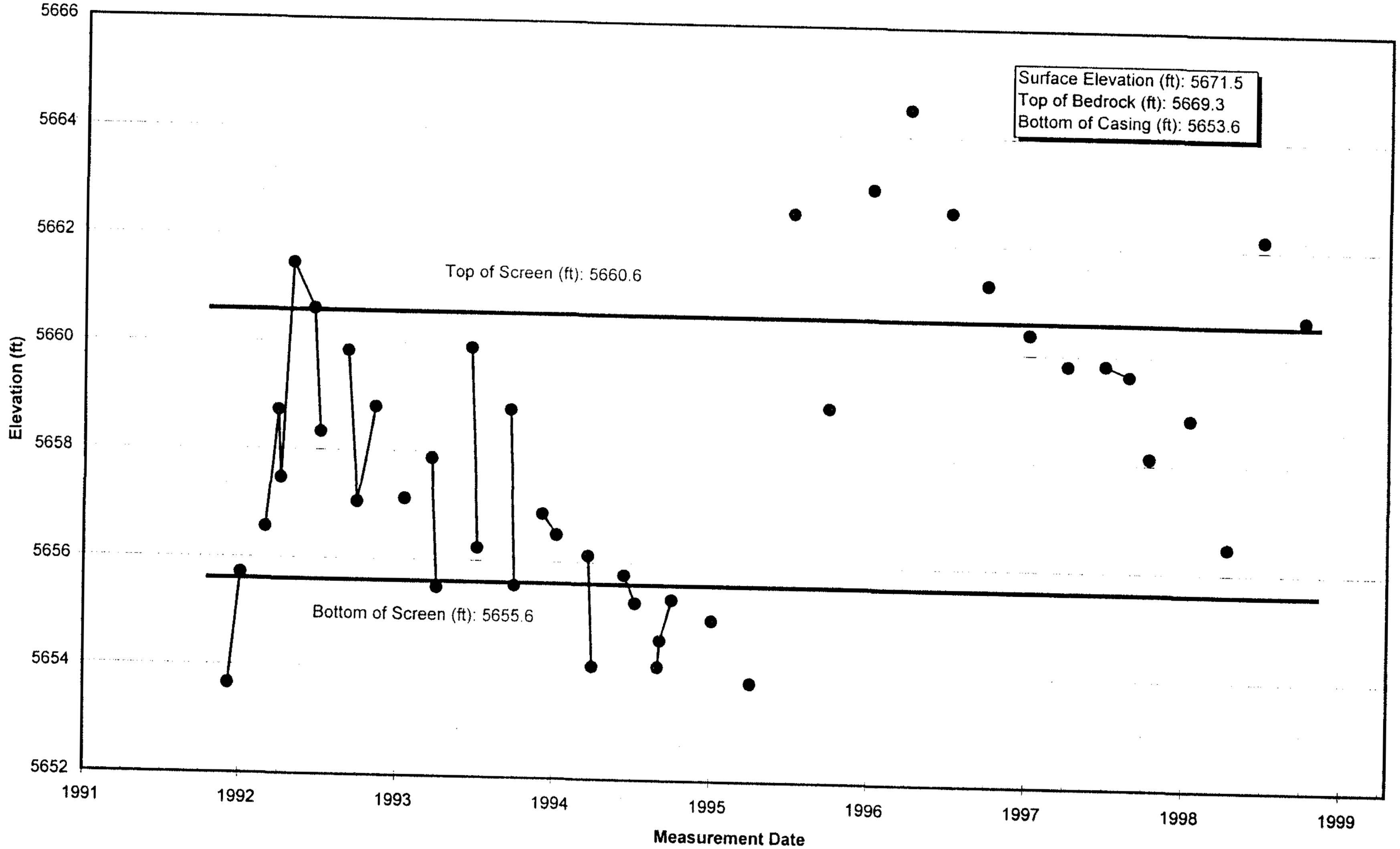
Hydrograph 06091



S3_97. 1 9/22/99

273 272

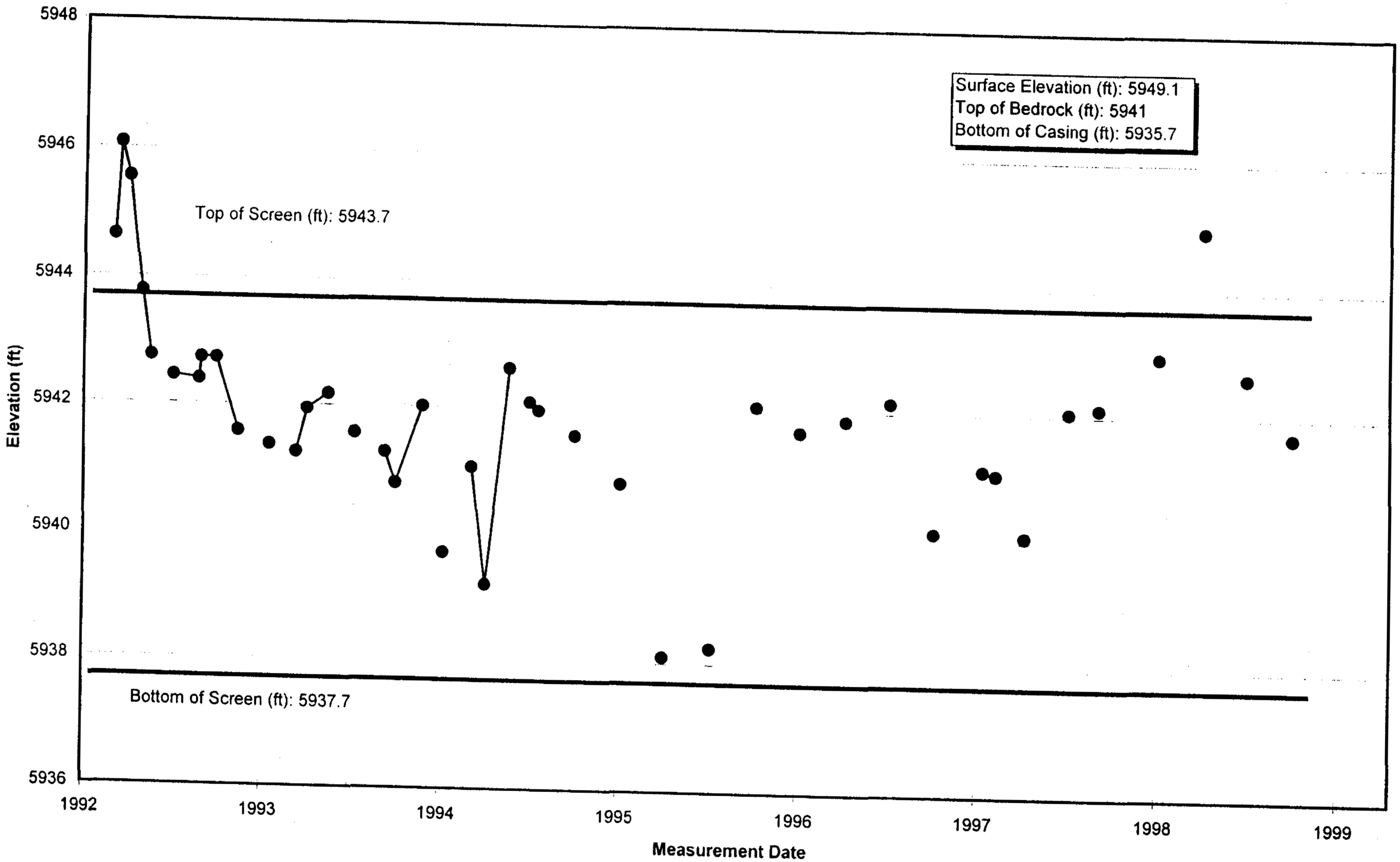
Hydrograph 06491



S4_97.xls 06491 9/22/99

274-273

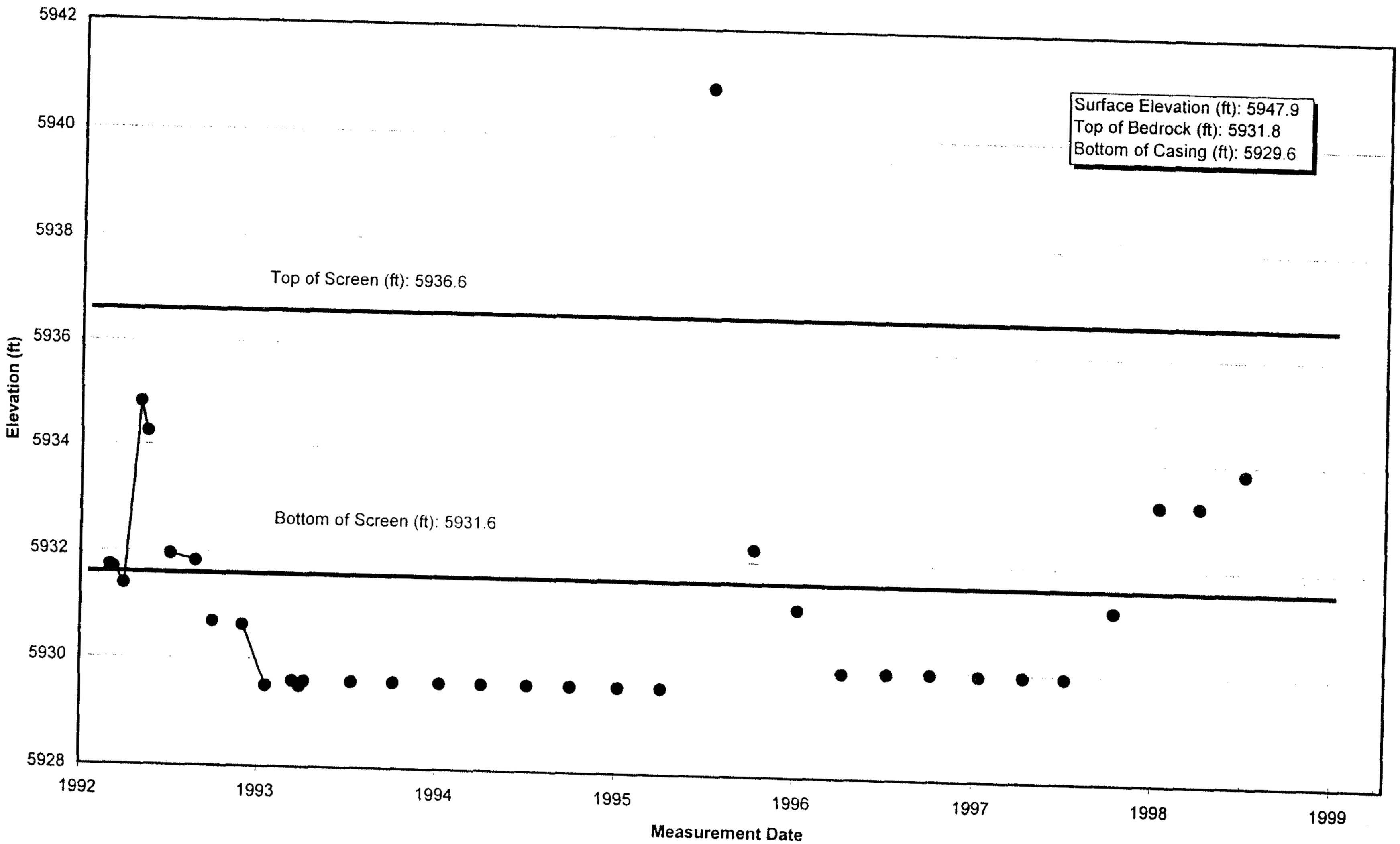
Hydrograph 07391



S4_97_ 91 9/22/99

275 274

Hydrograph 08091



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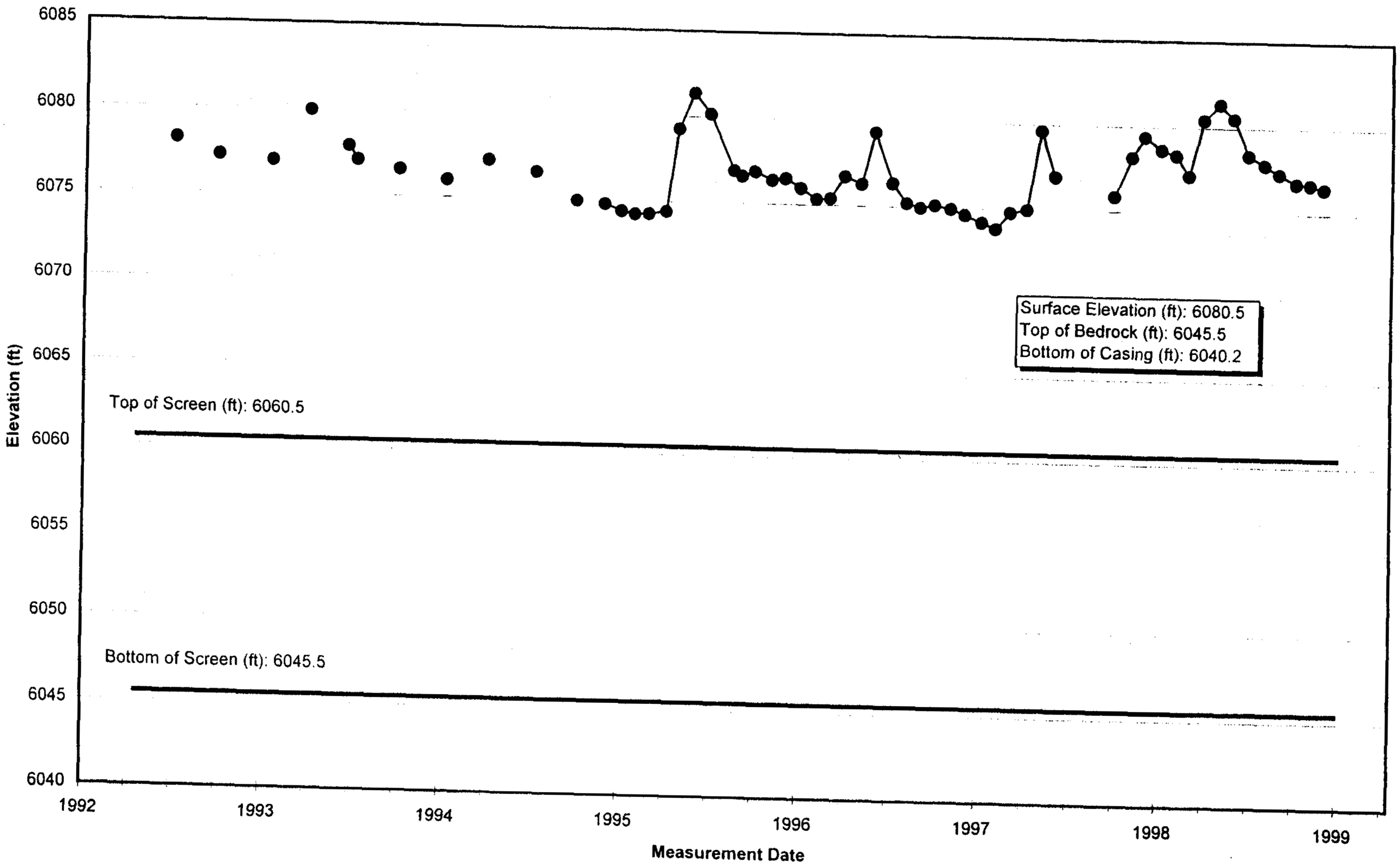
276275

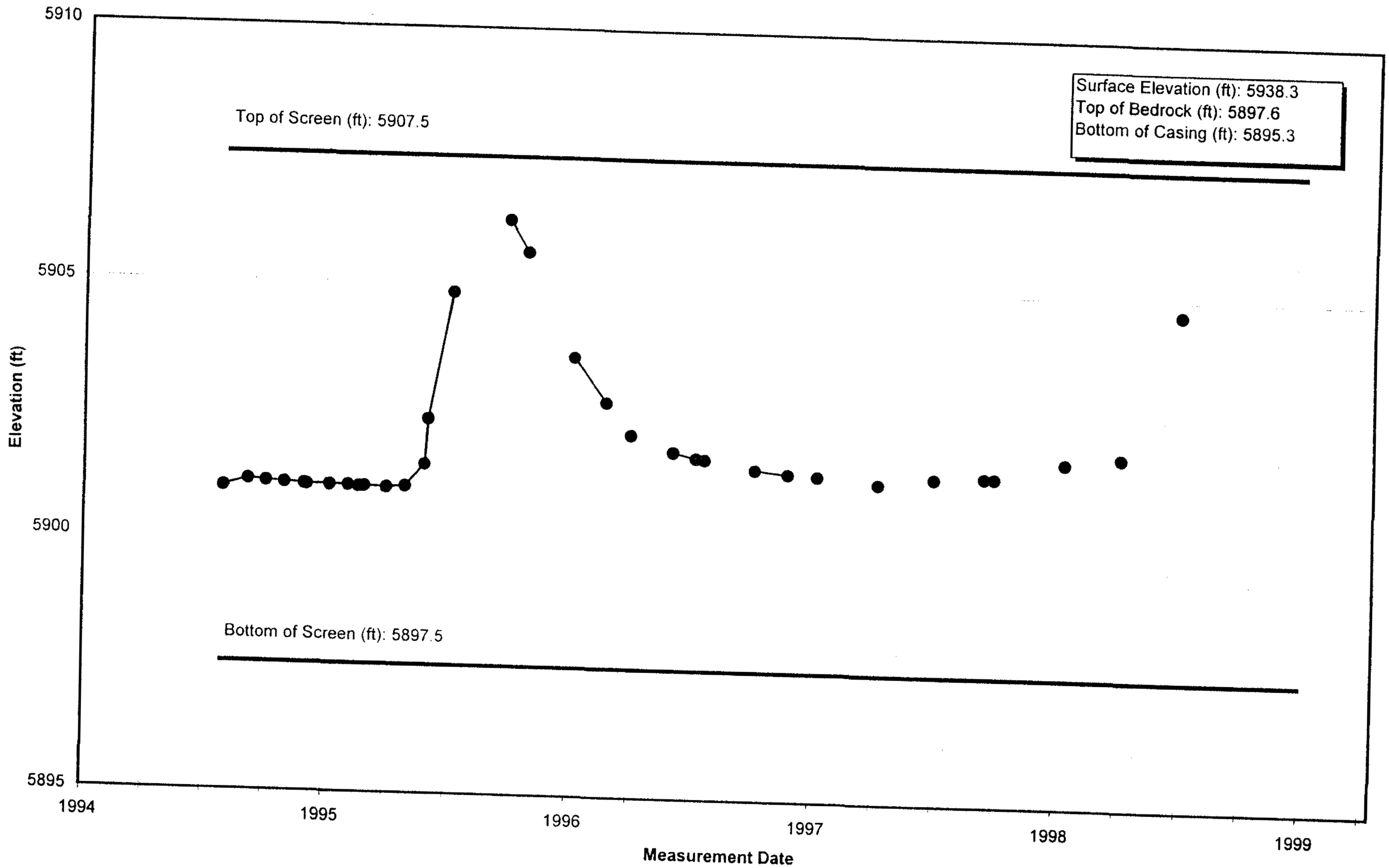
Hydrograph 0990



S5_97.x 9/22/99

277 276

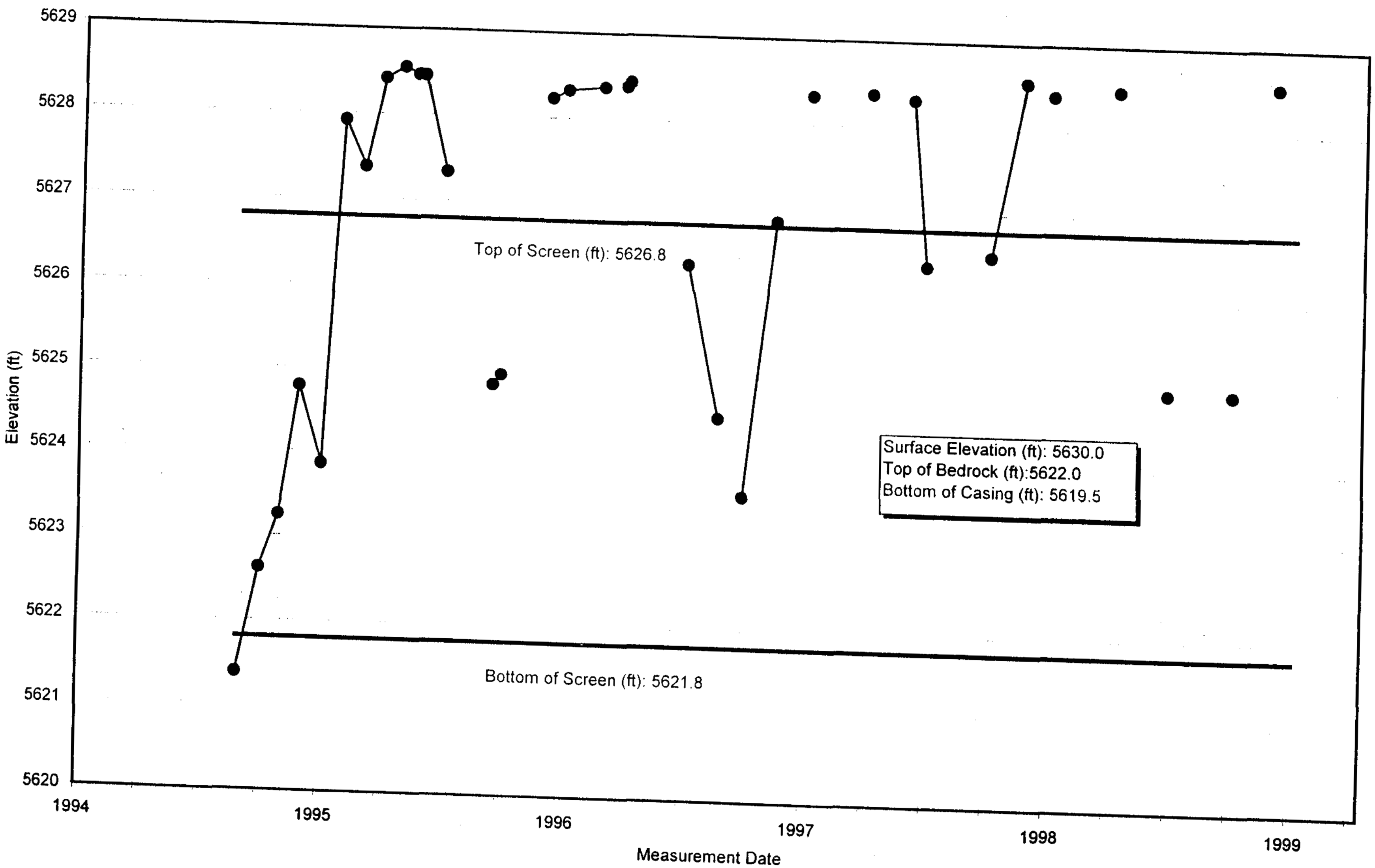
Hydrograph 10194



S5_97.xls 10194 9/22/99

~~278~~ 277

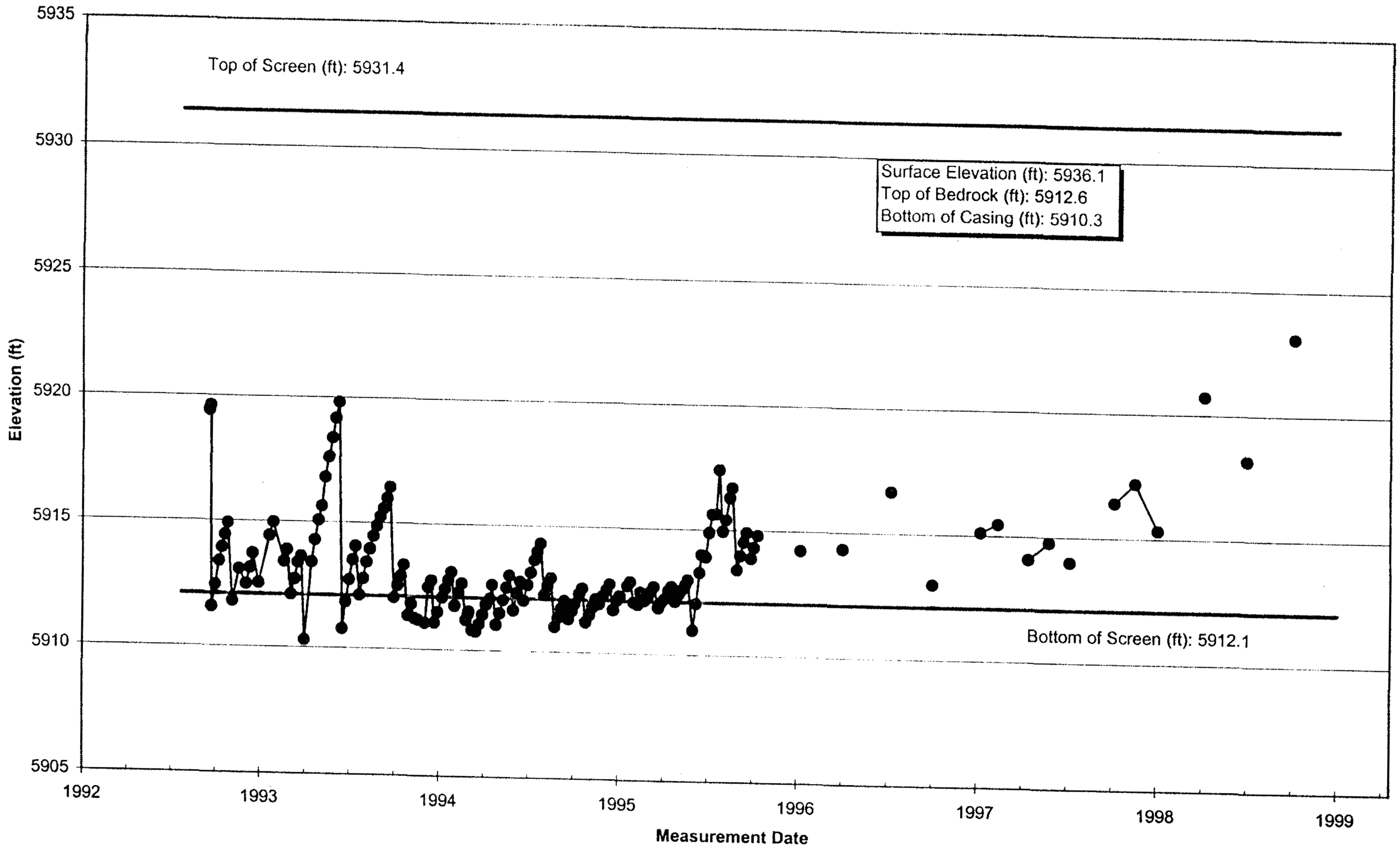
Hydrograph 10394



S5_97.xl 9/22/99

279 278

Hydrograph 10592



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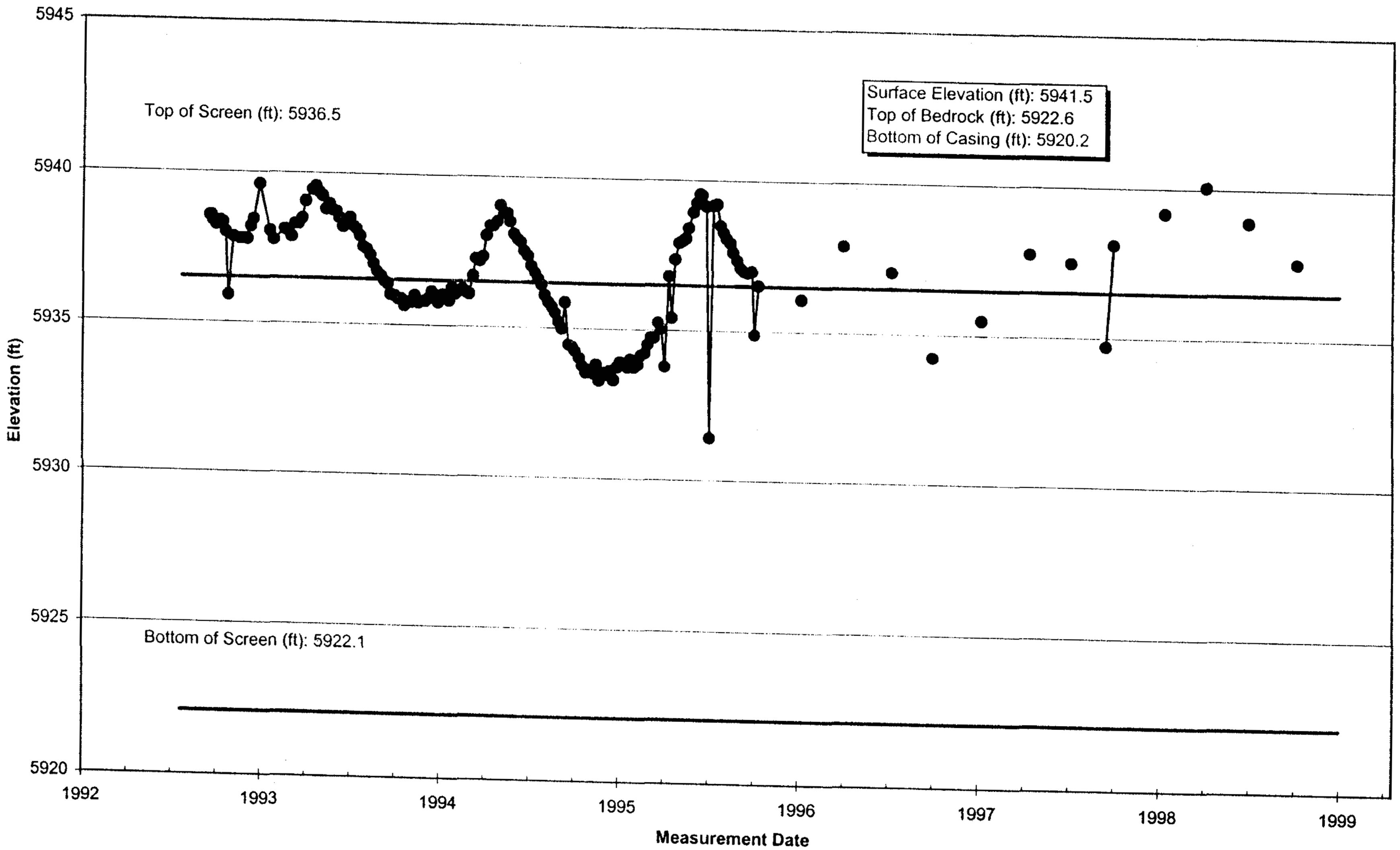
280 279

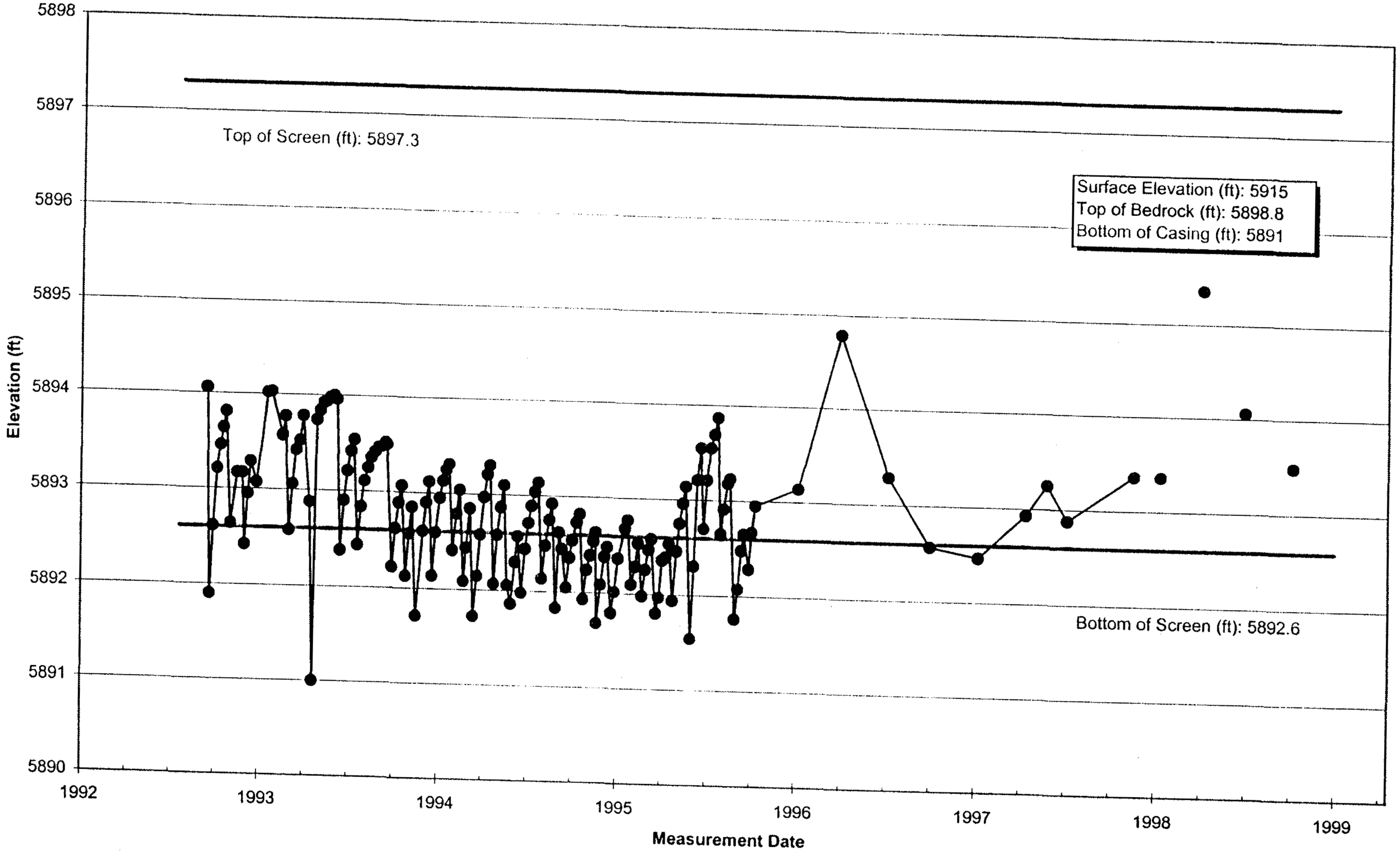
Hydrograph 10692



S5_98 2 9/27/99

284 280

Hydrograph 10792



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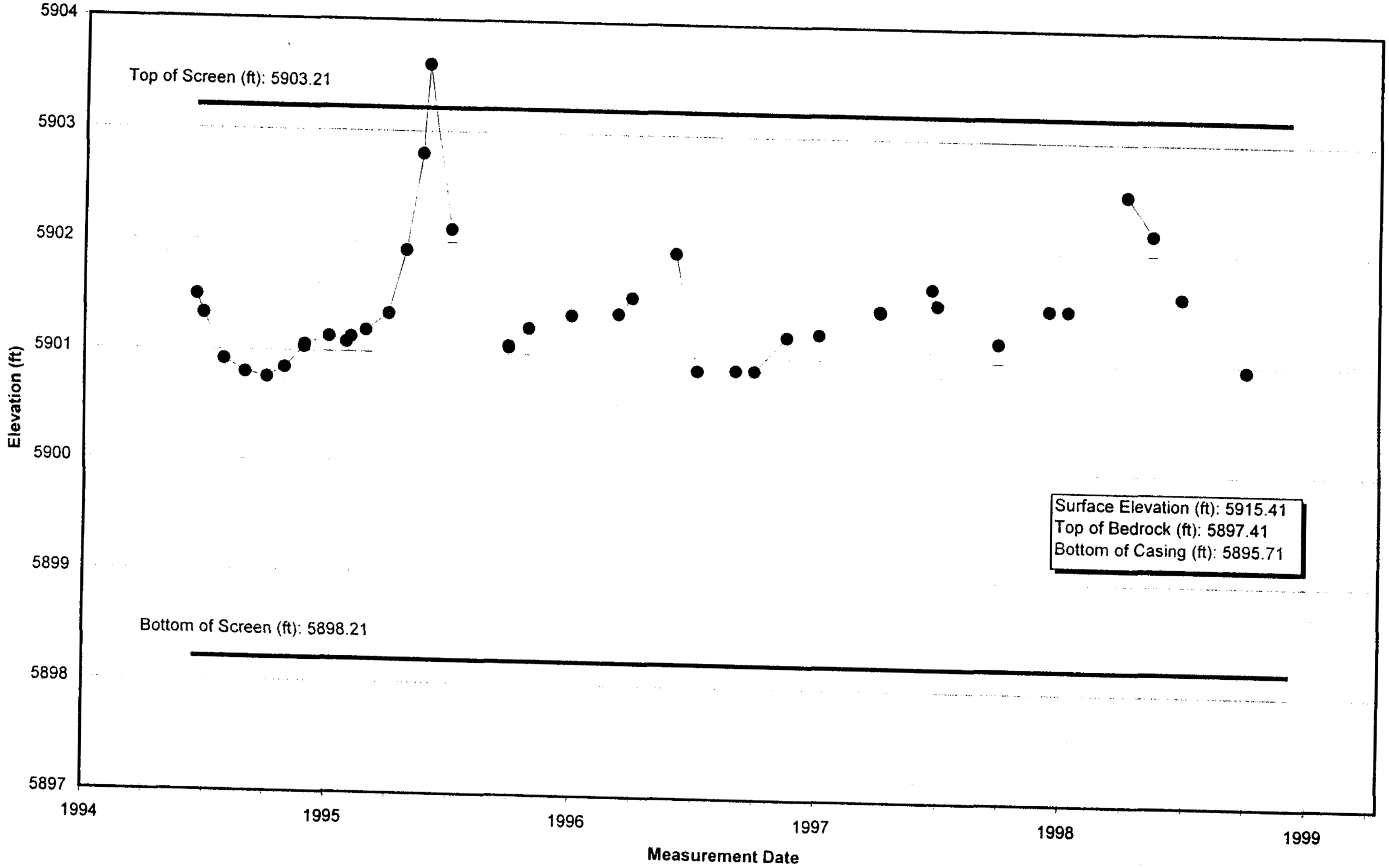
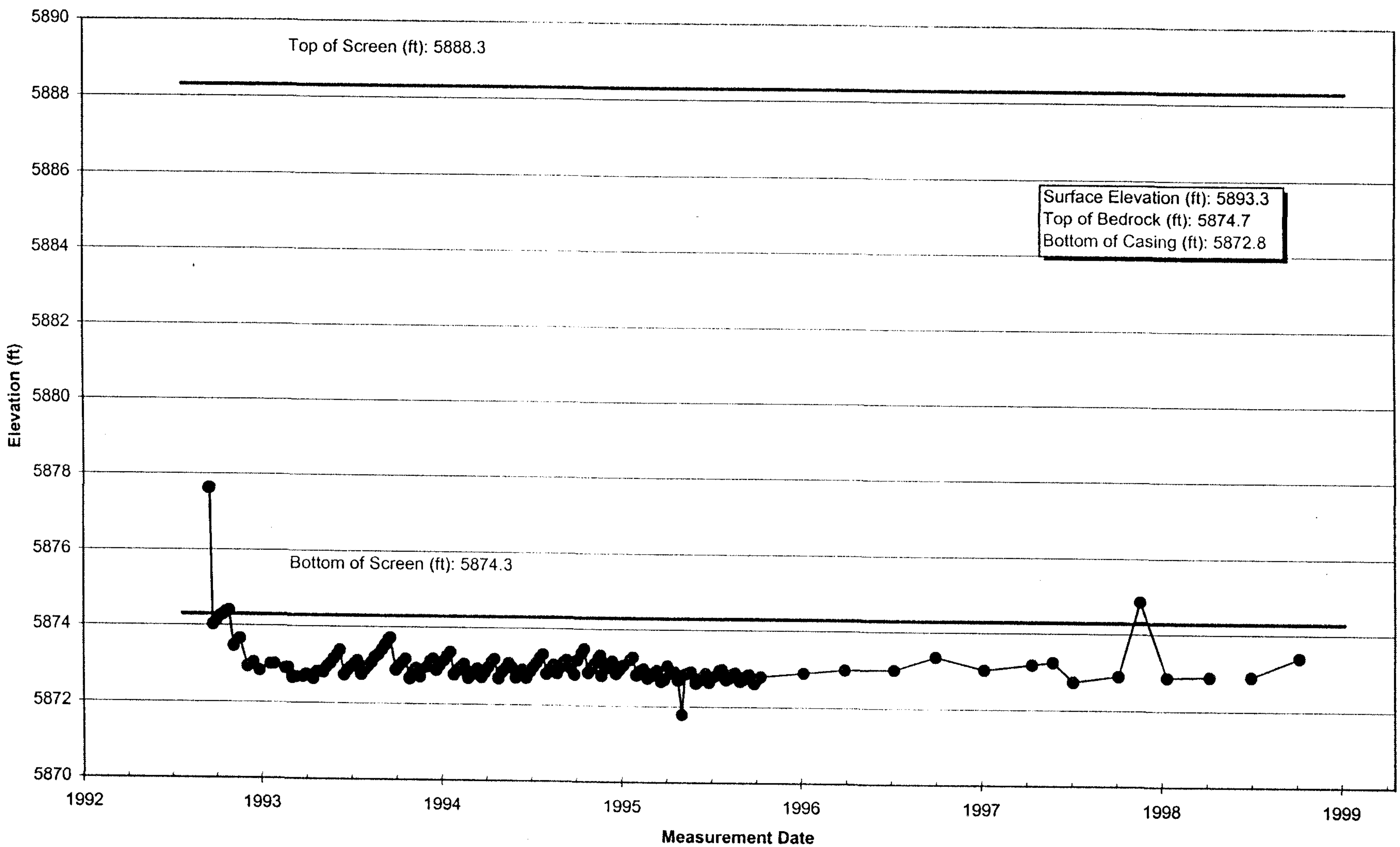
282 281

Hydrograph 10994



Hydrograph 11092



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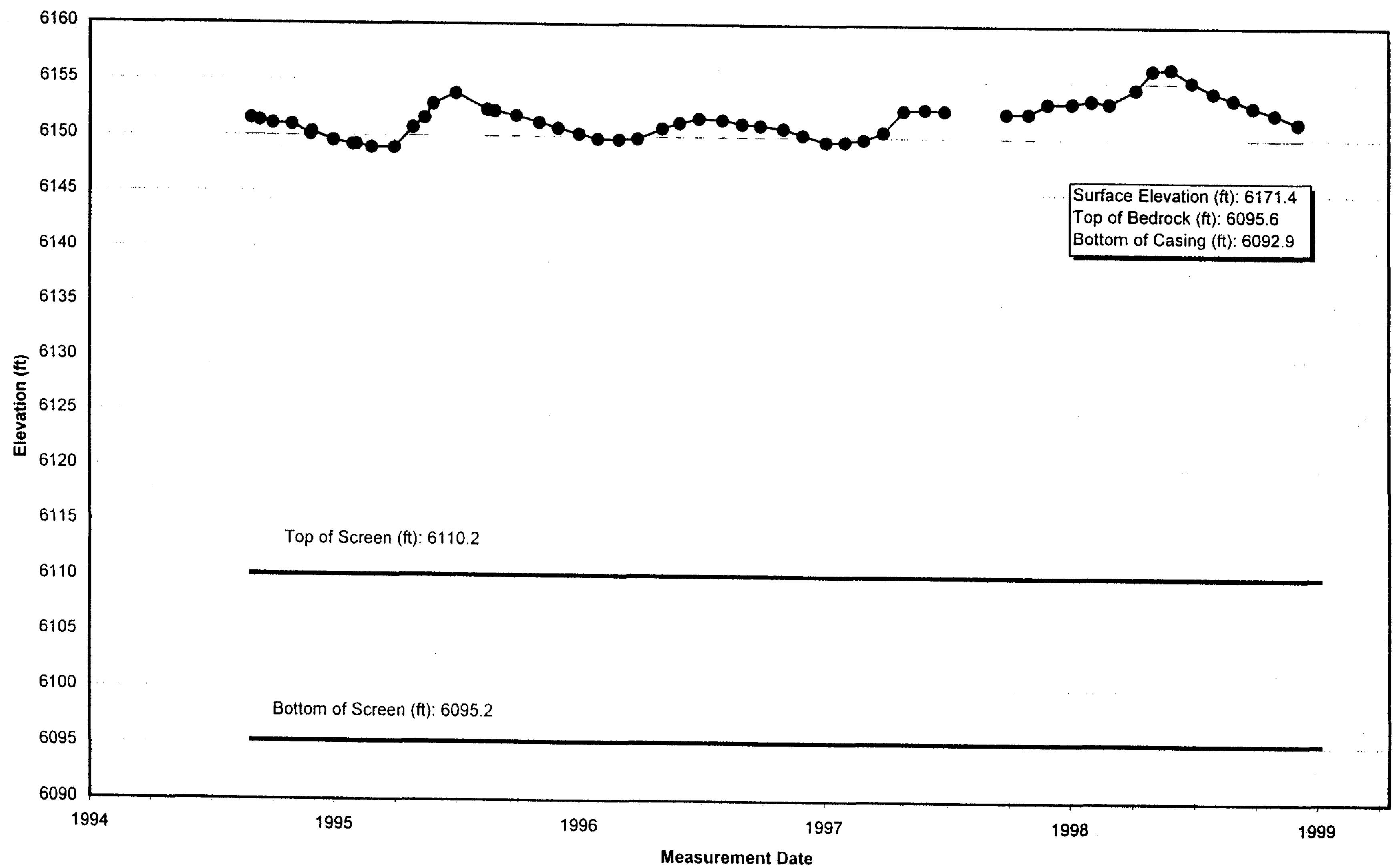

S5_98.x 9/22/99

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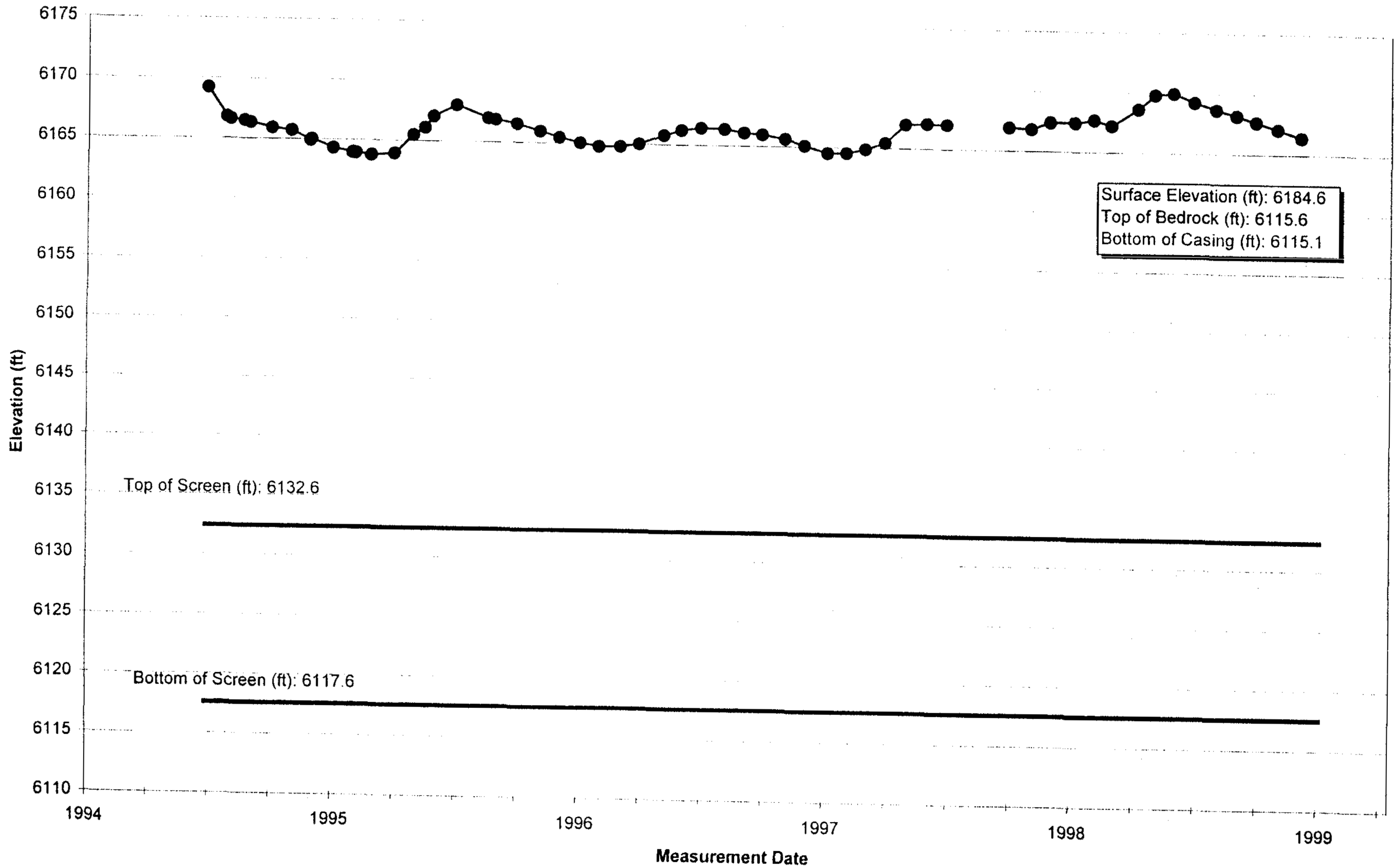
Hydrograph 11494



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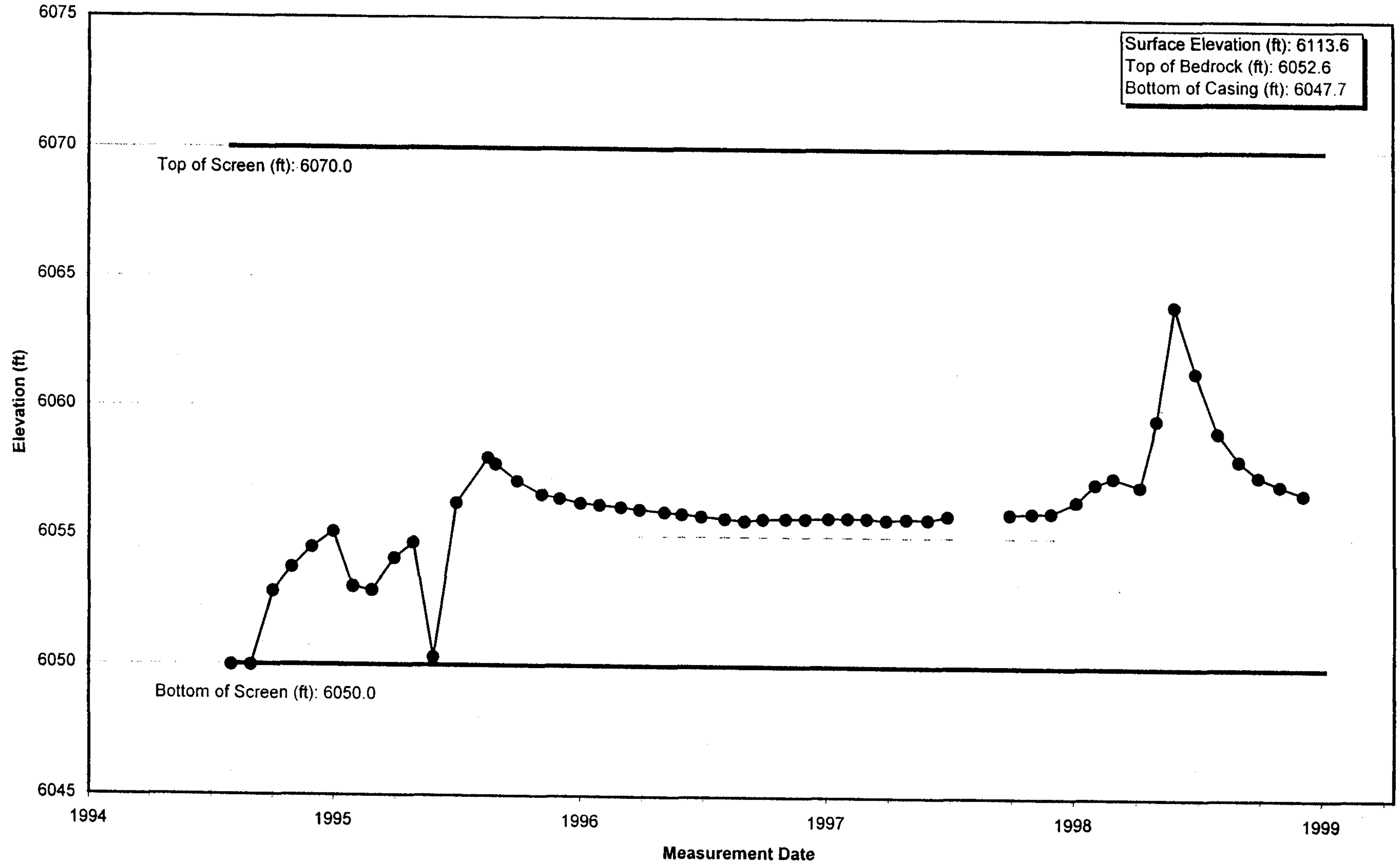
286 285

Hydrograph 11594



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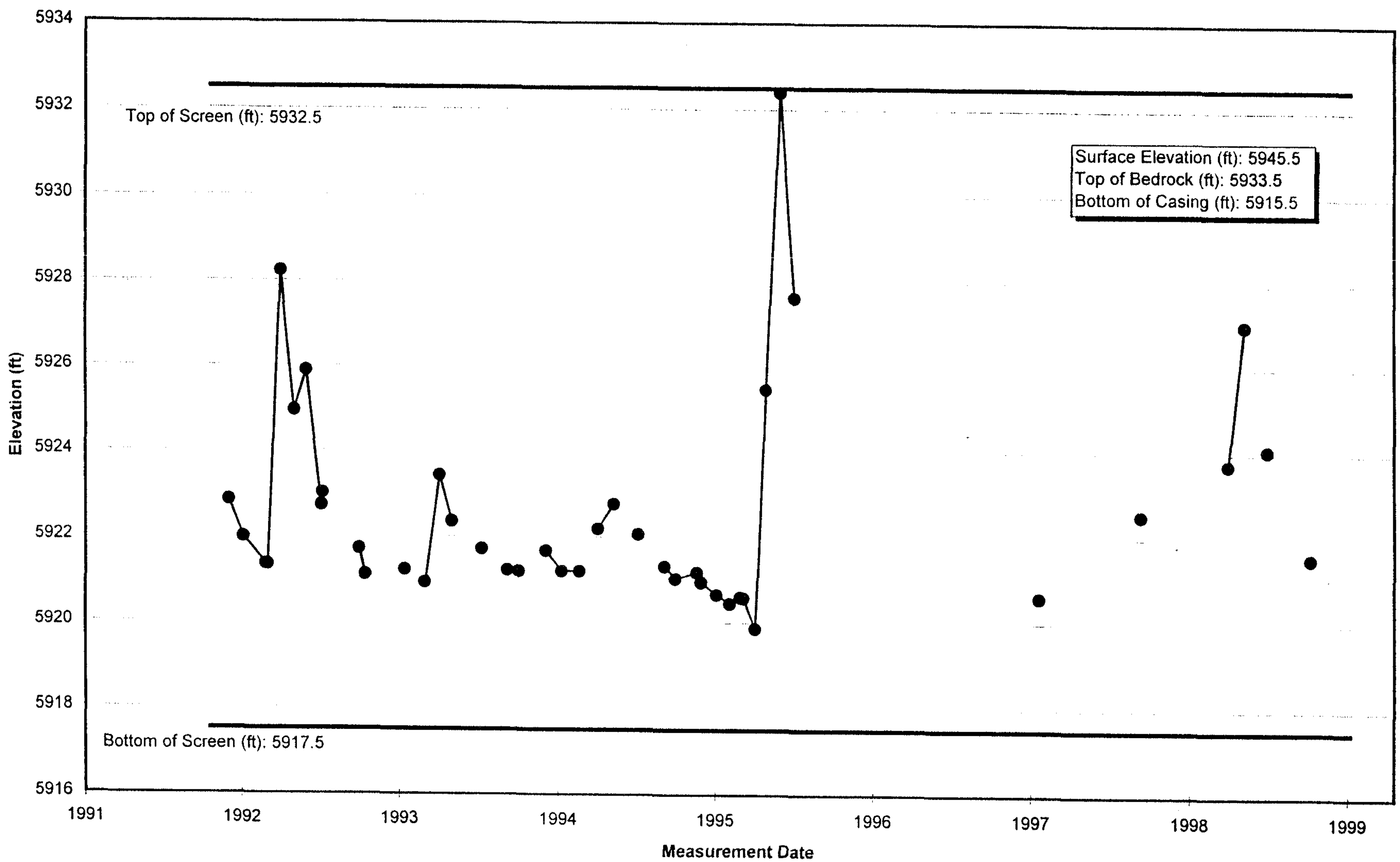
Hydrograph 11891



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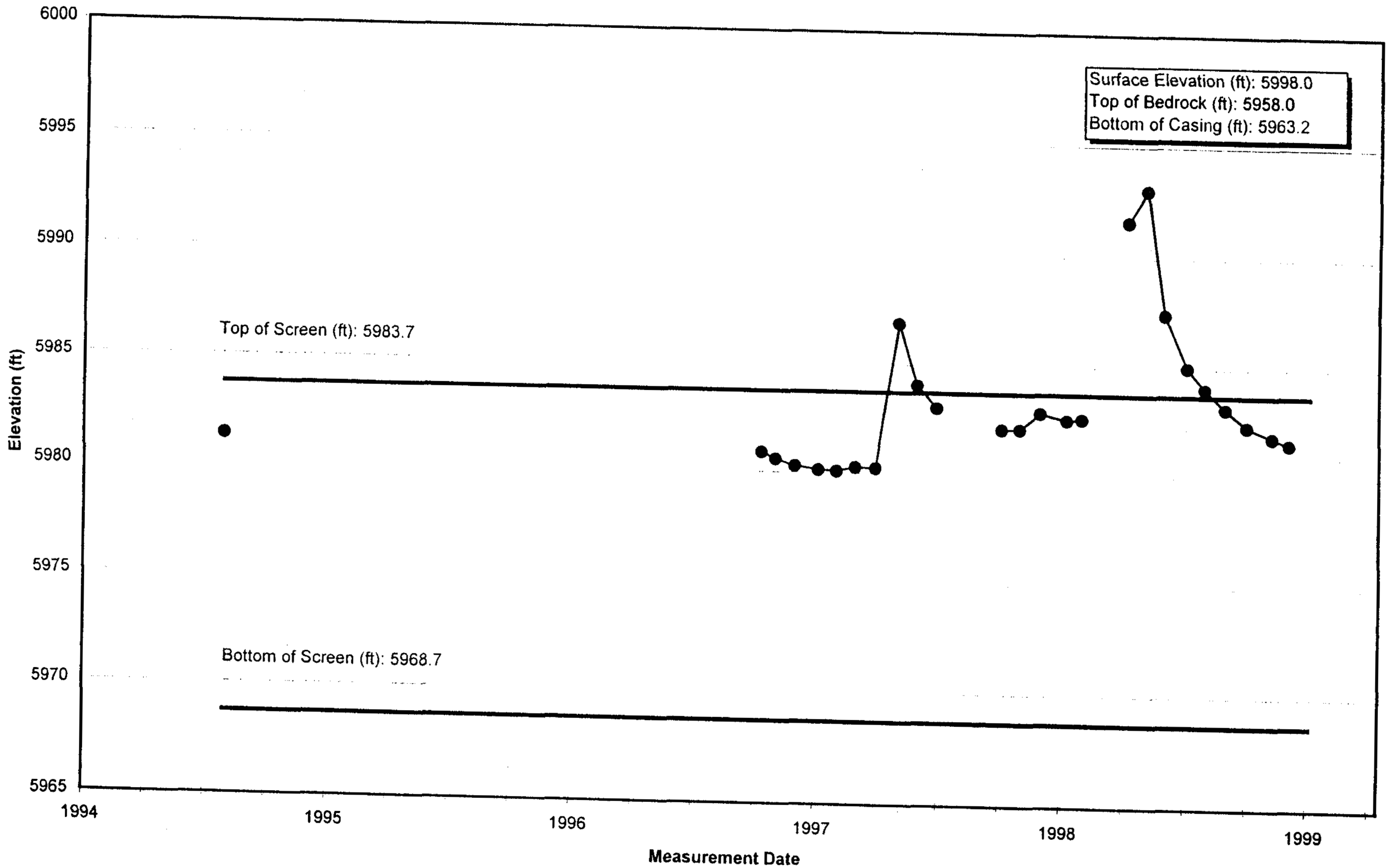
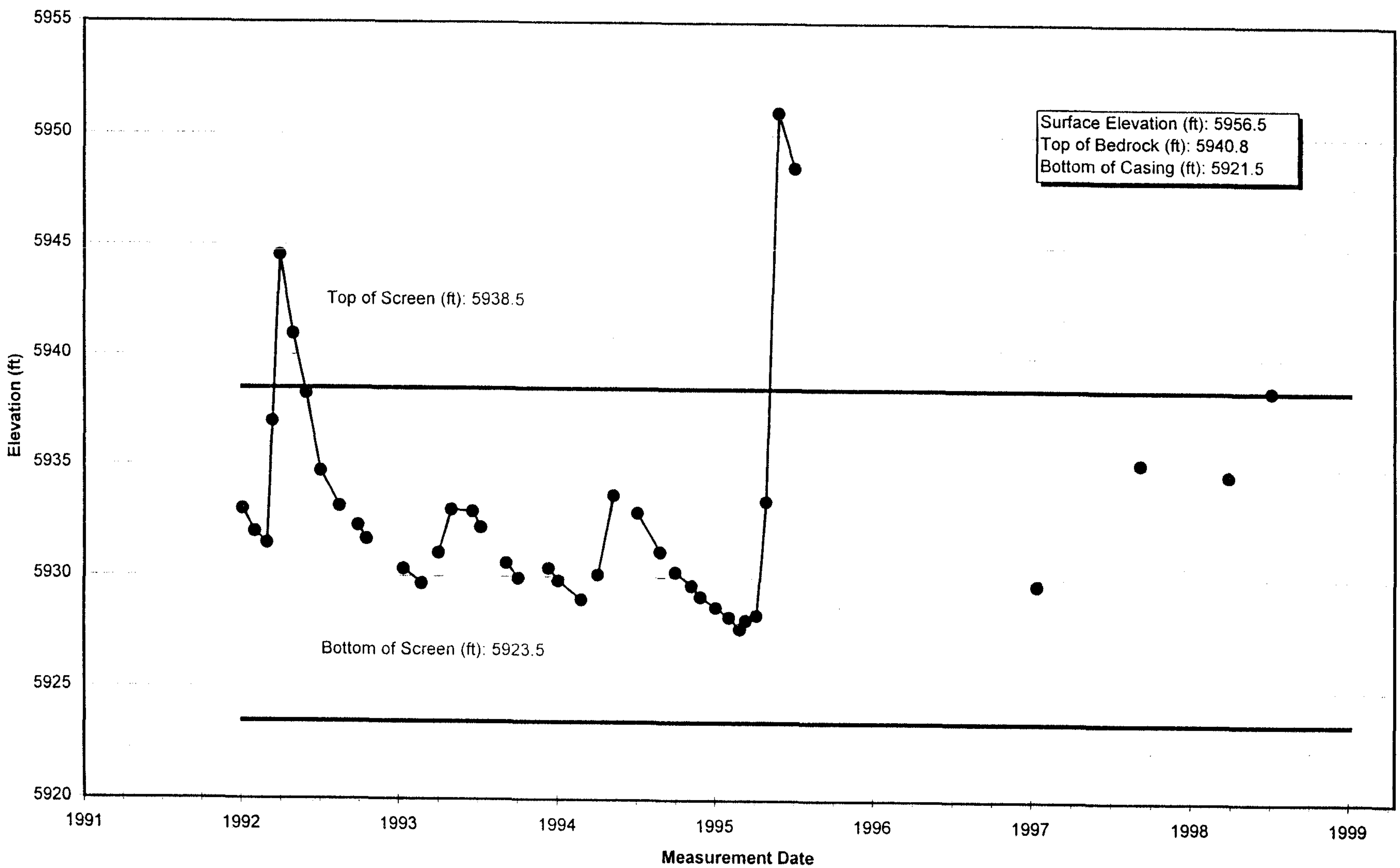
Hydrograph 1190



S5_98.x 9/22/99

284 288

Hydrograph 12191



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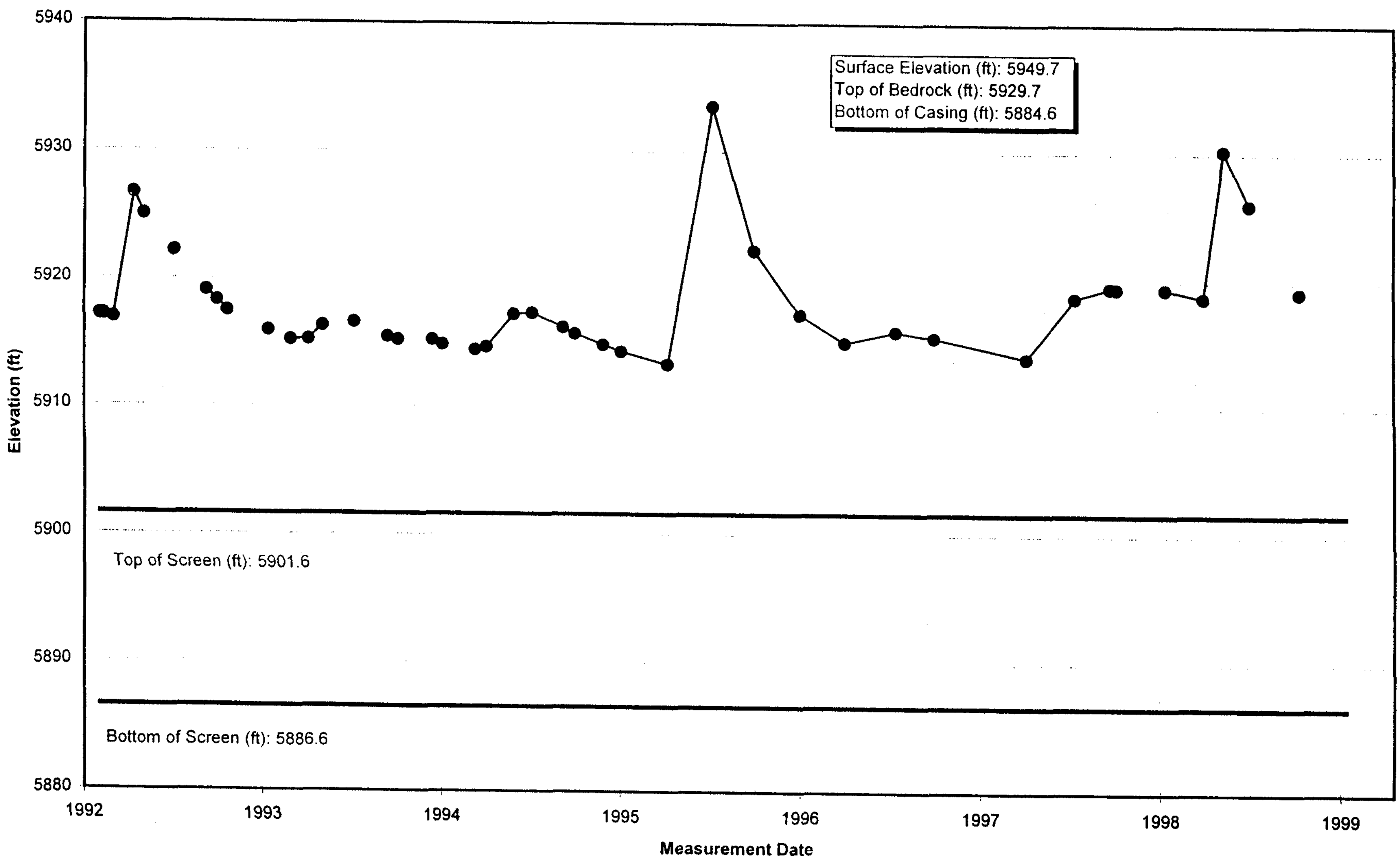
280 289

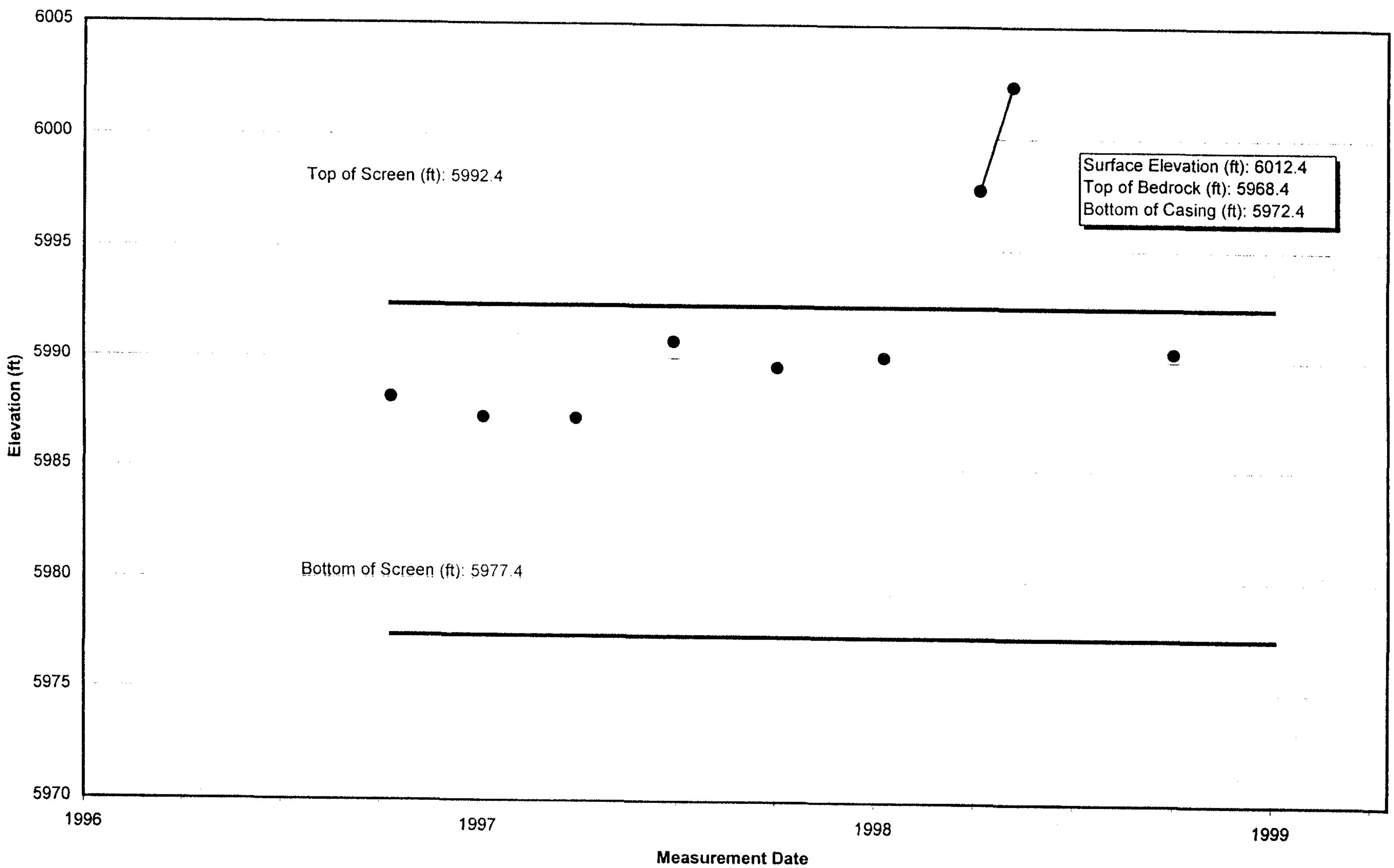
Hydrograph 12691



S6_97. 1 9/22/99

291 290

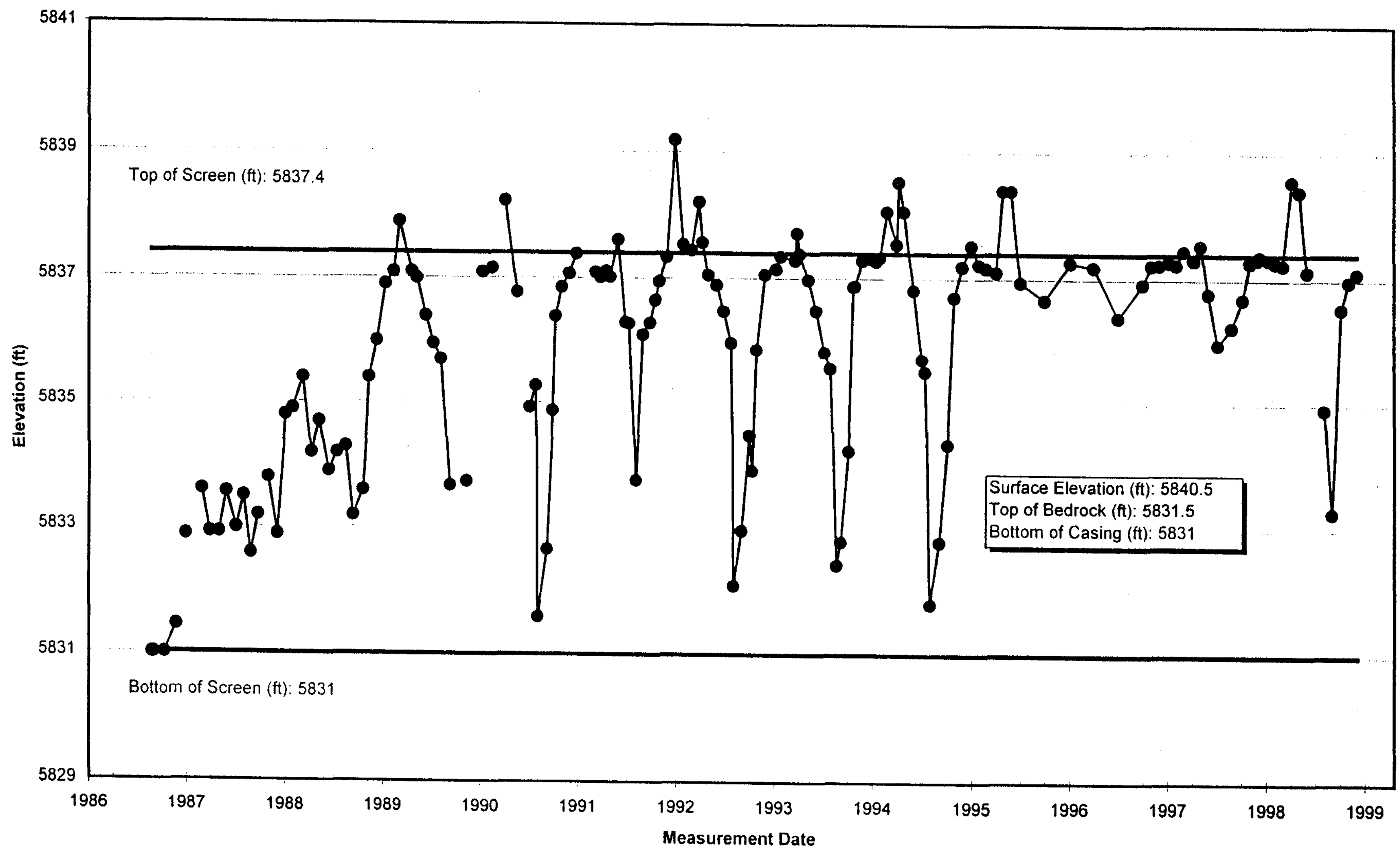
Hydrograph 1290



S6_97.xls 1290 9/22/99

~~292~~ 291

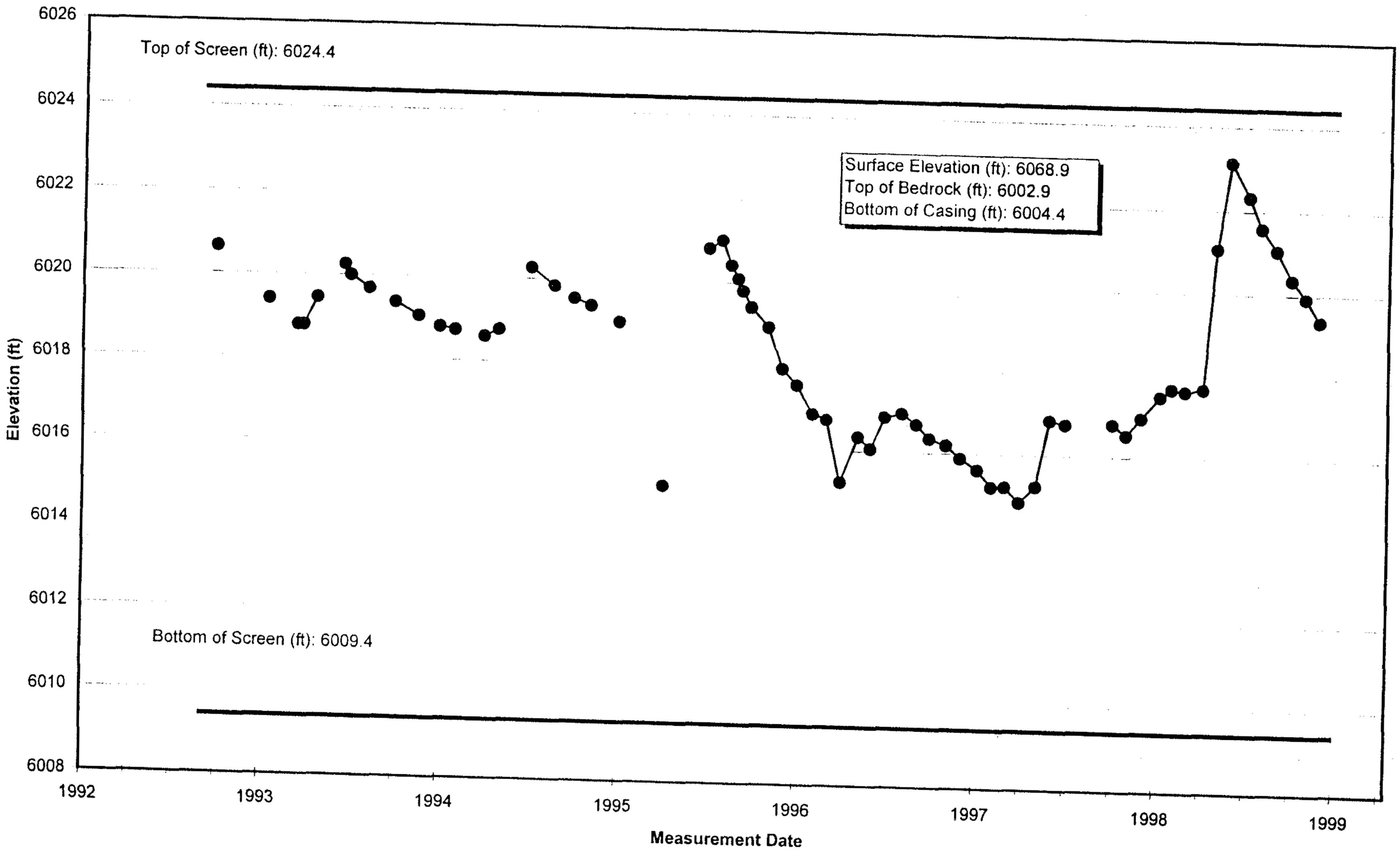
Hydrograph 1386



S6_97.x 9/22/99

283 292

Hydrograph 1490



S6_97.xls 1490 9/22/99

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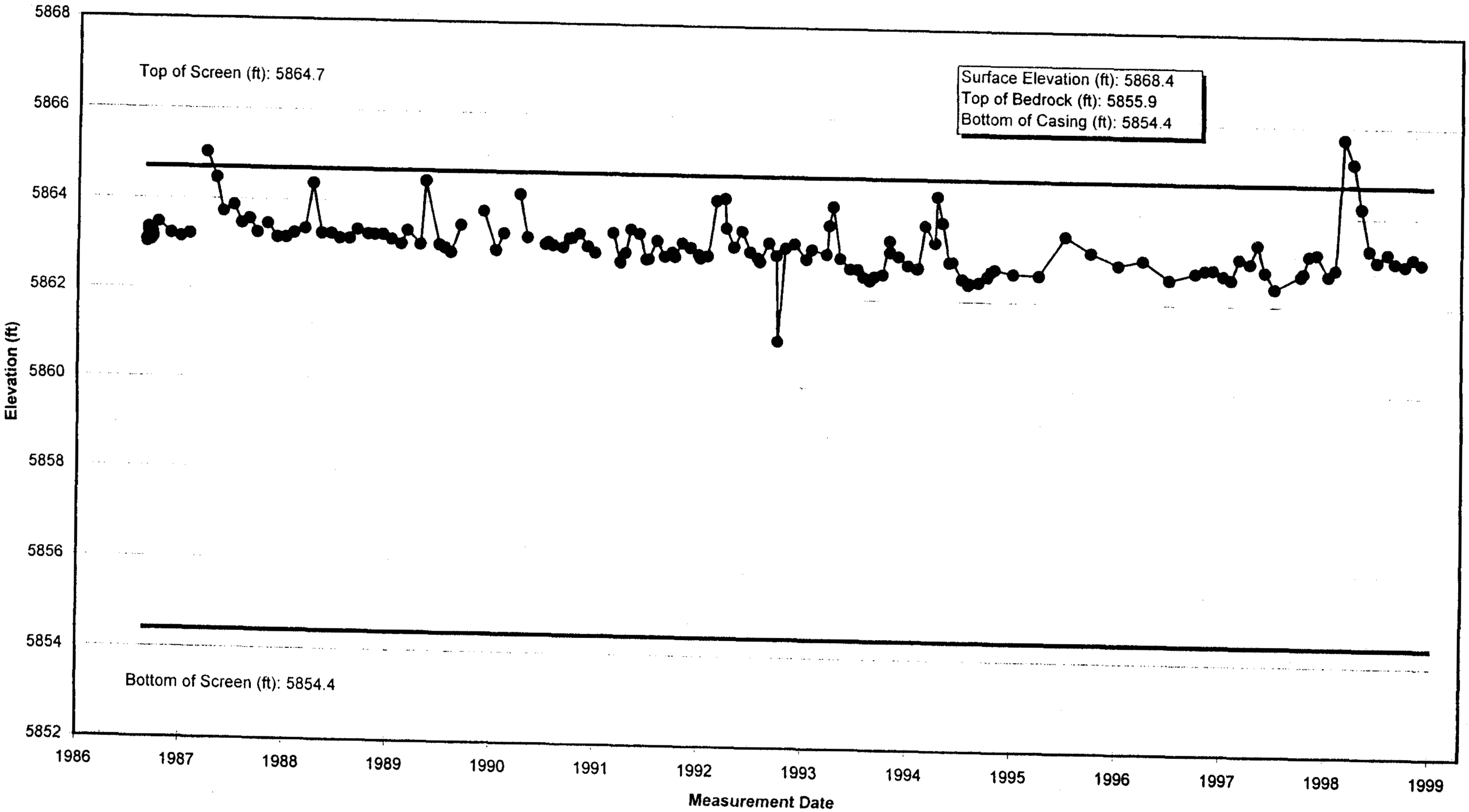
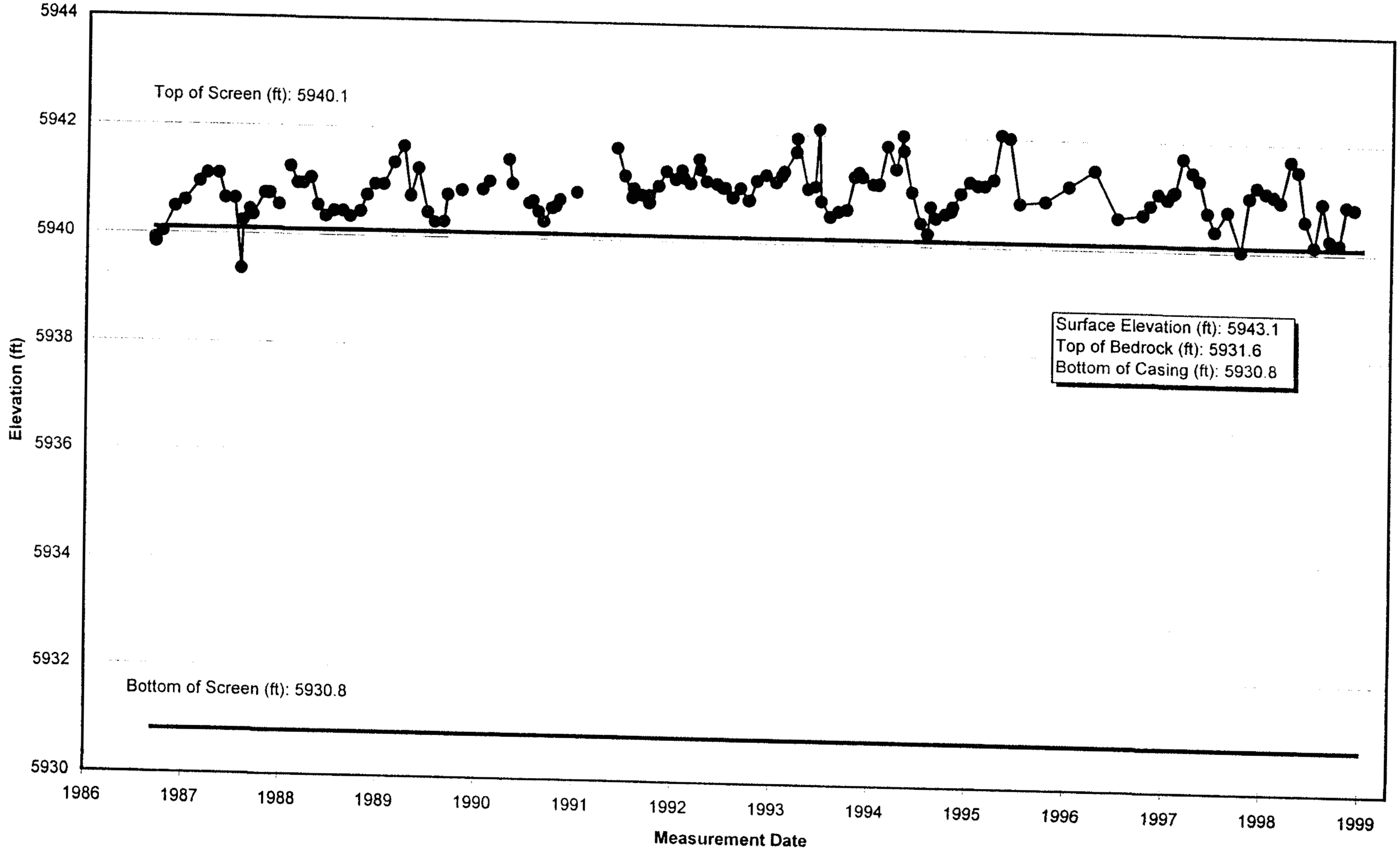
Hydrograph 1786



S6_97.xl 9/22/99

285 294

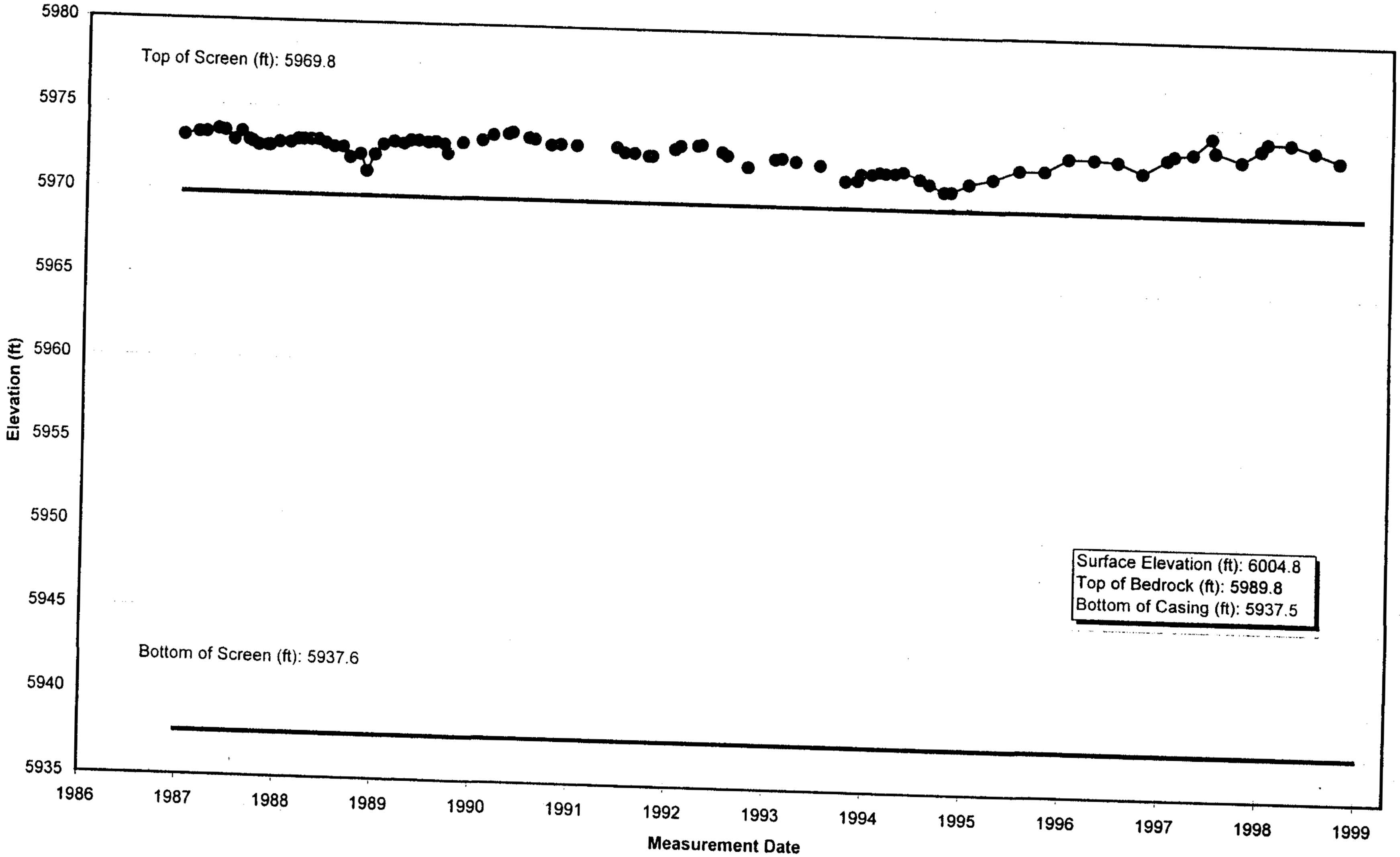
Hydrograph 1986



S7_97.xls 1986 9/22/99

296,295

Hydrograph 2186



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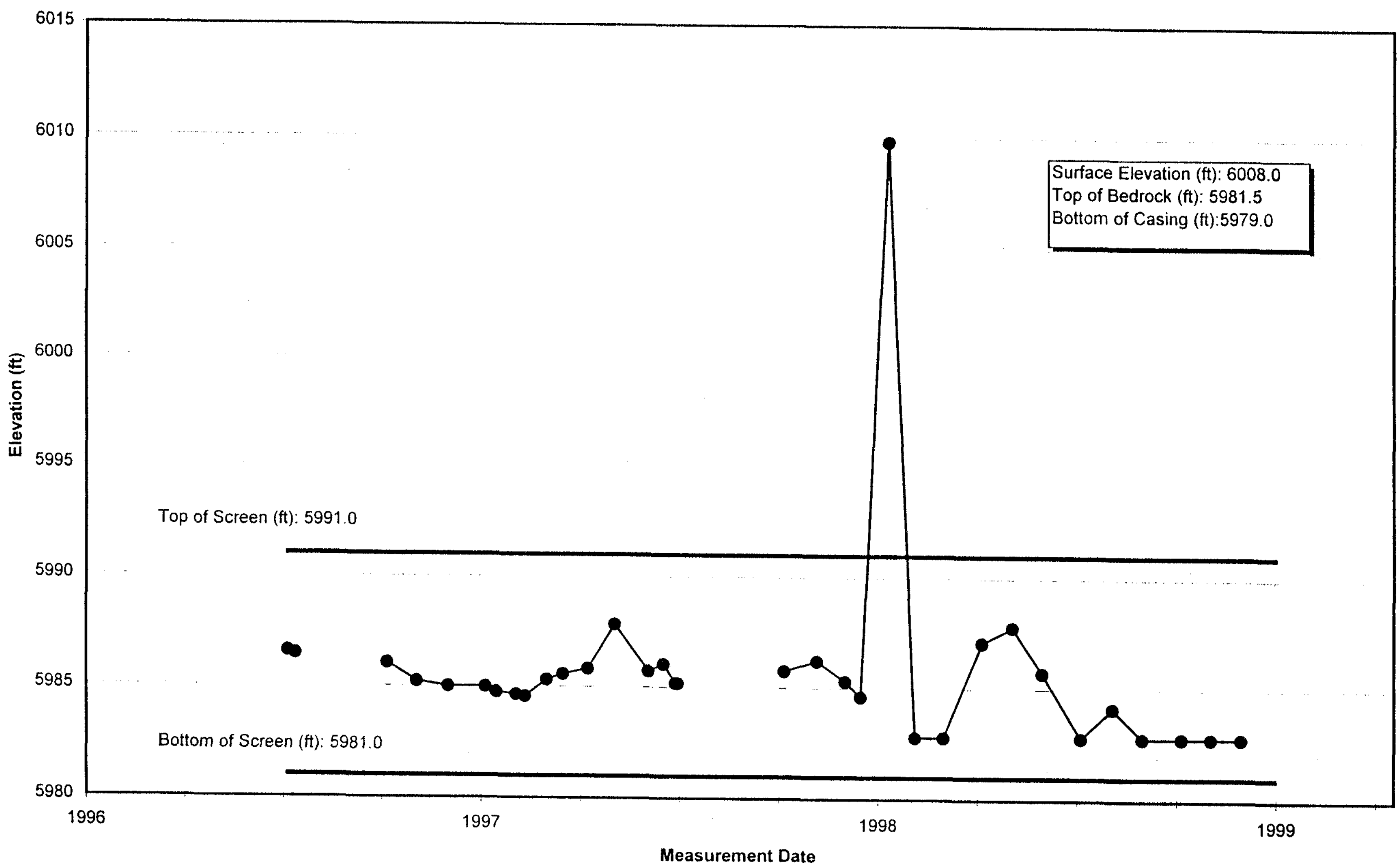
Hydrograph 22596



S7_97.xls 22596 9/22/99

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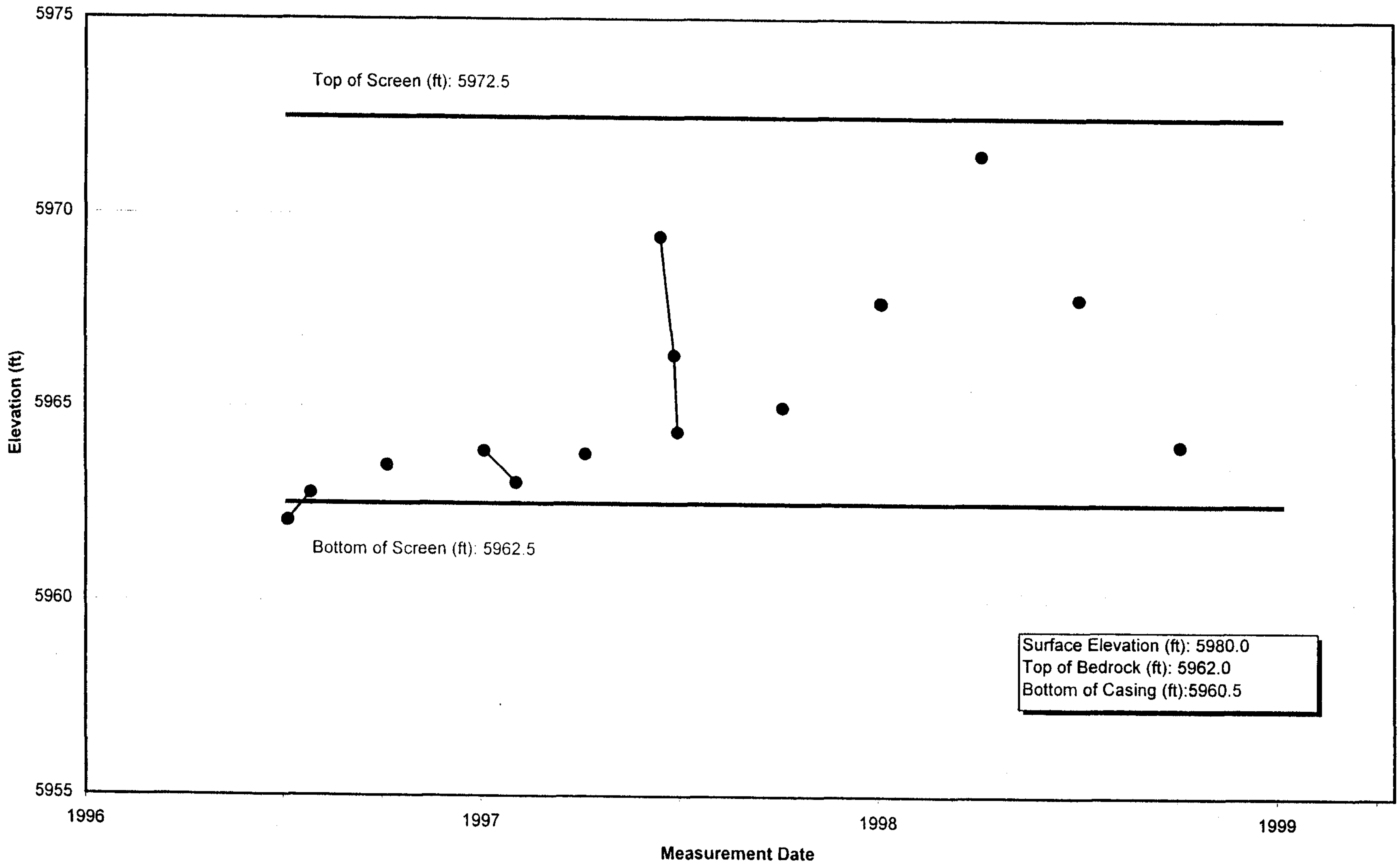
Hydrograph 22696



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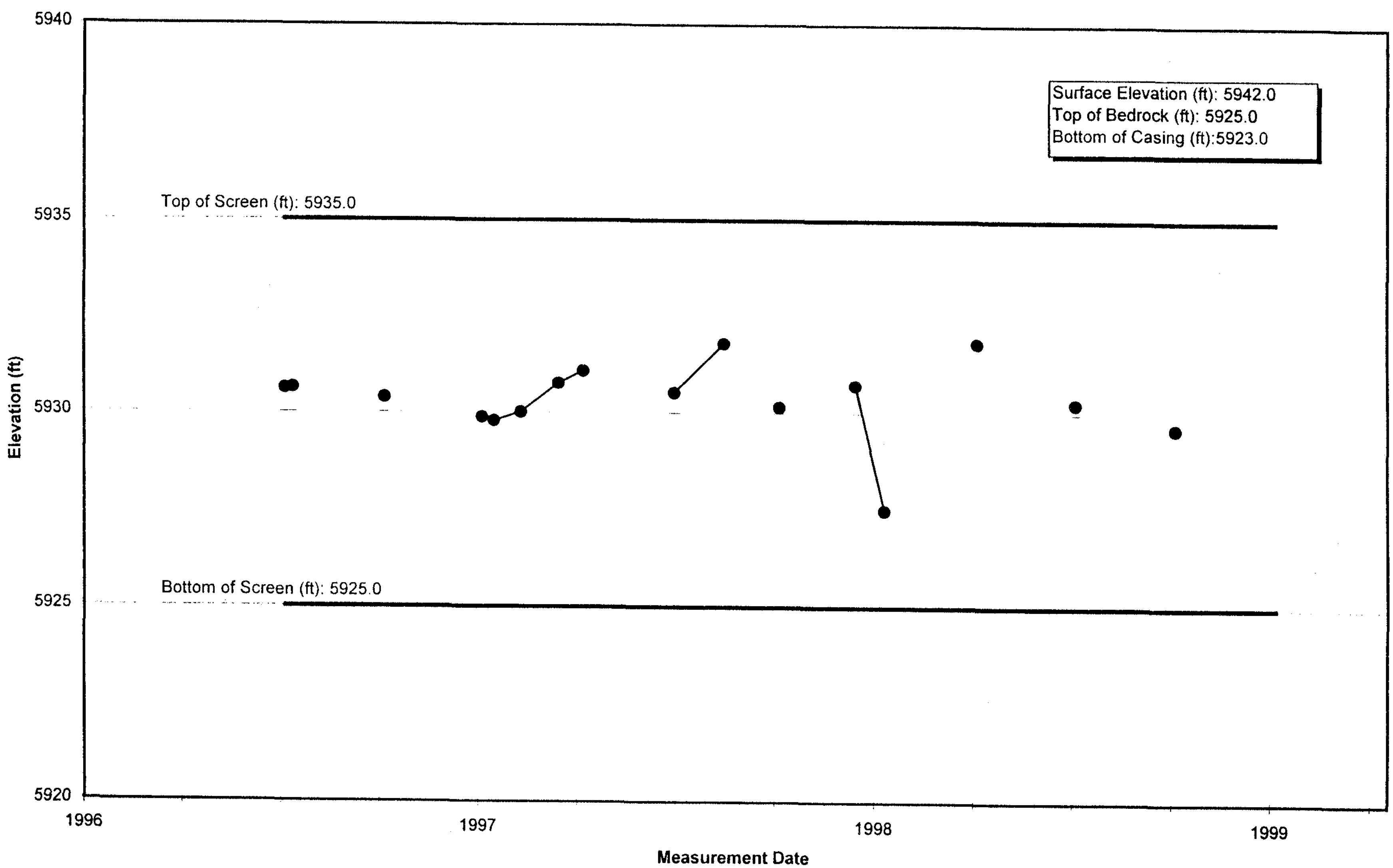
Hydrograph 22796



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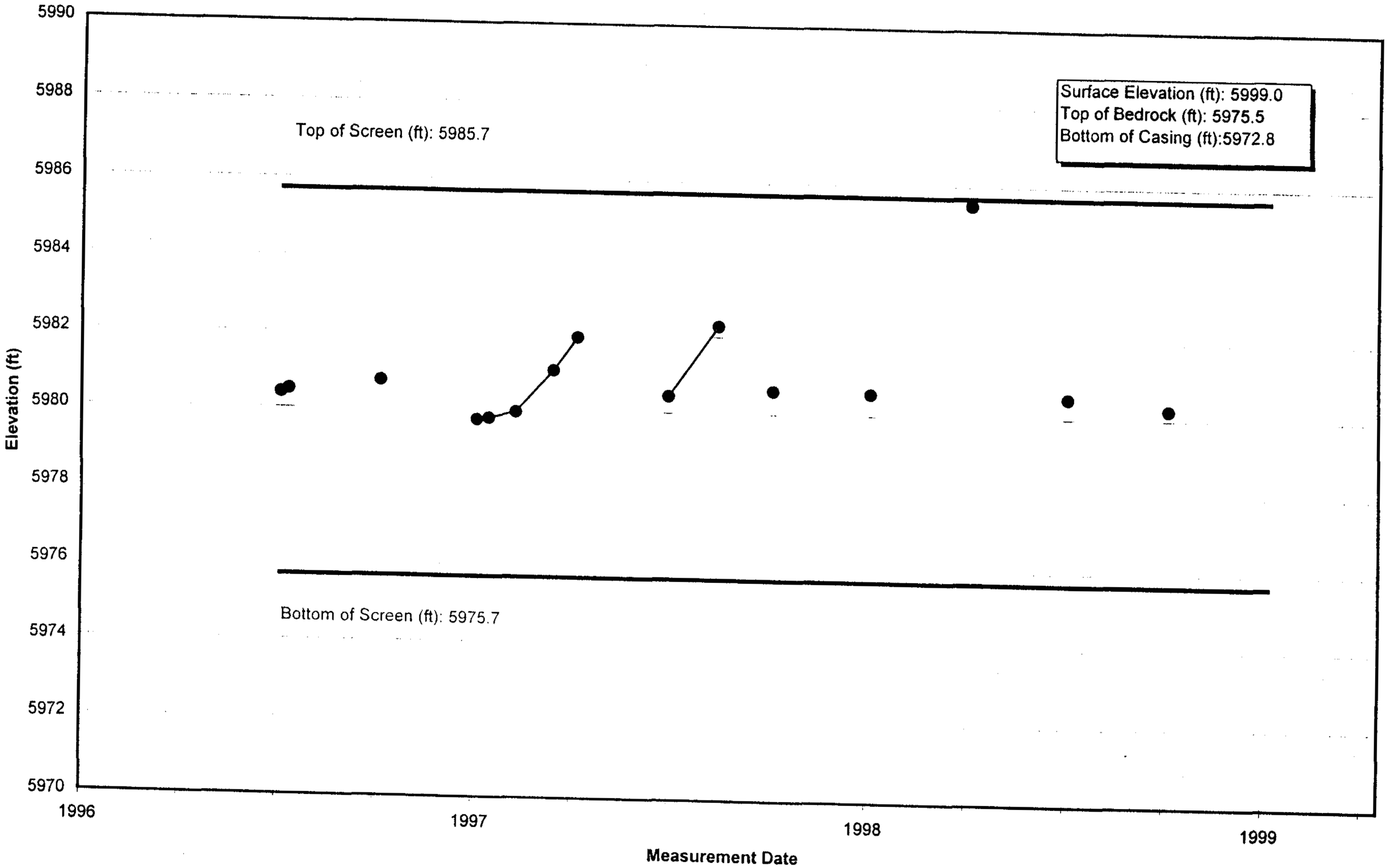
Hydrograph 22896



S7_97 6 9/22/99

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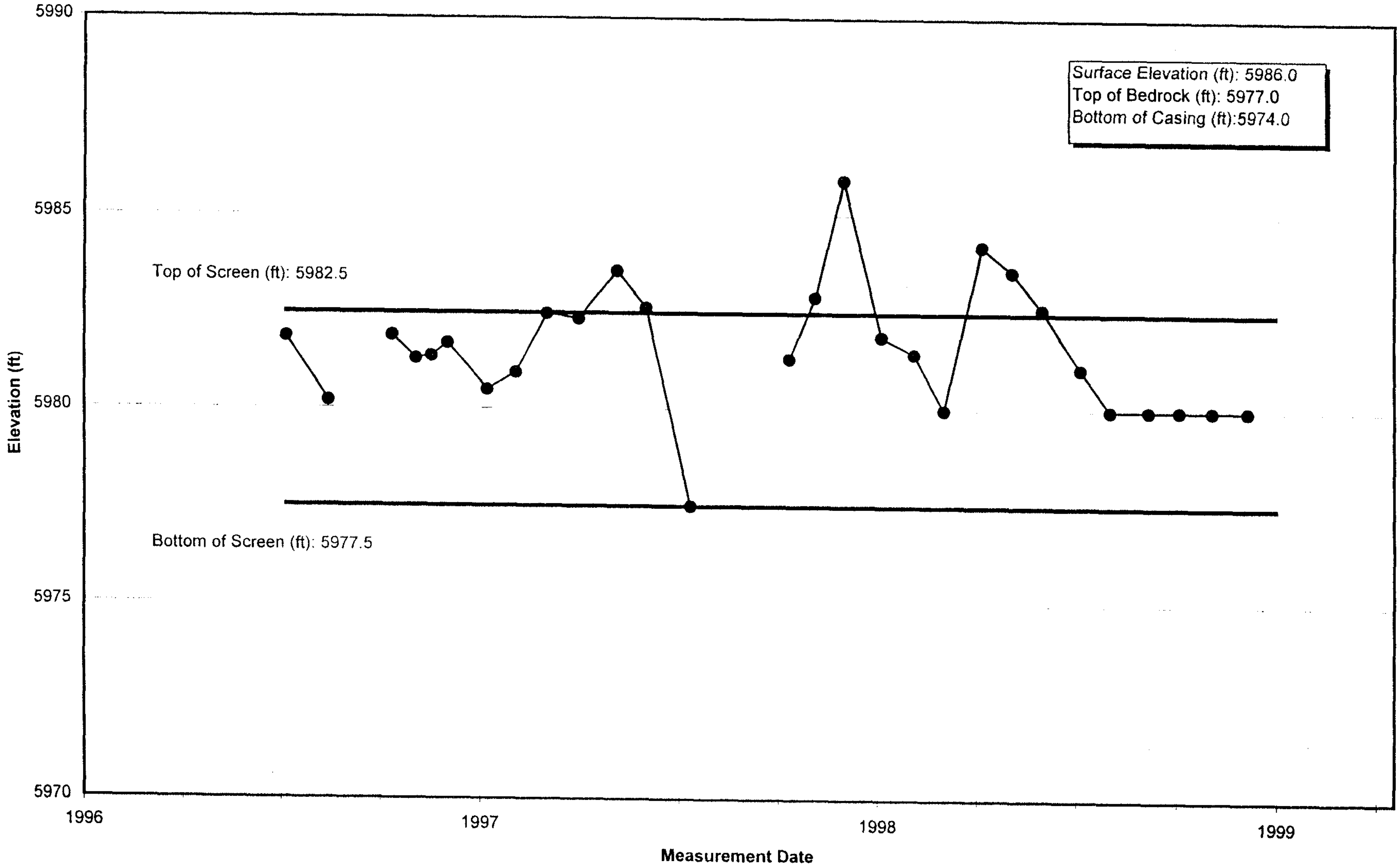
Hydrograph 22996



S7_97.xls 22996 9/22/99

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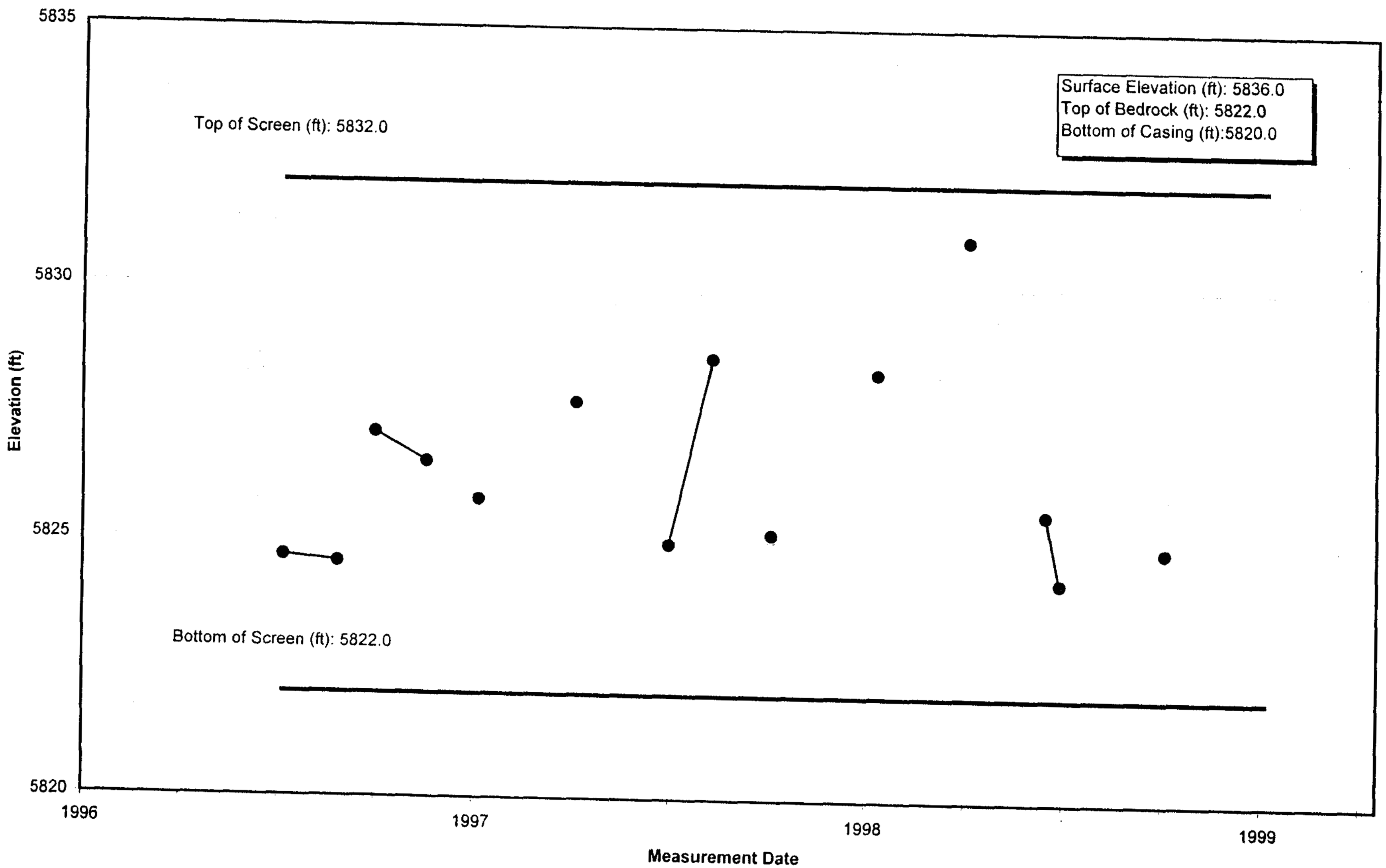
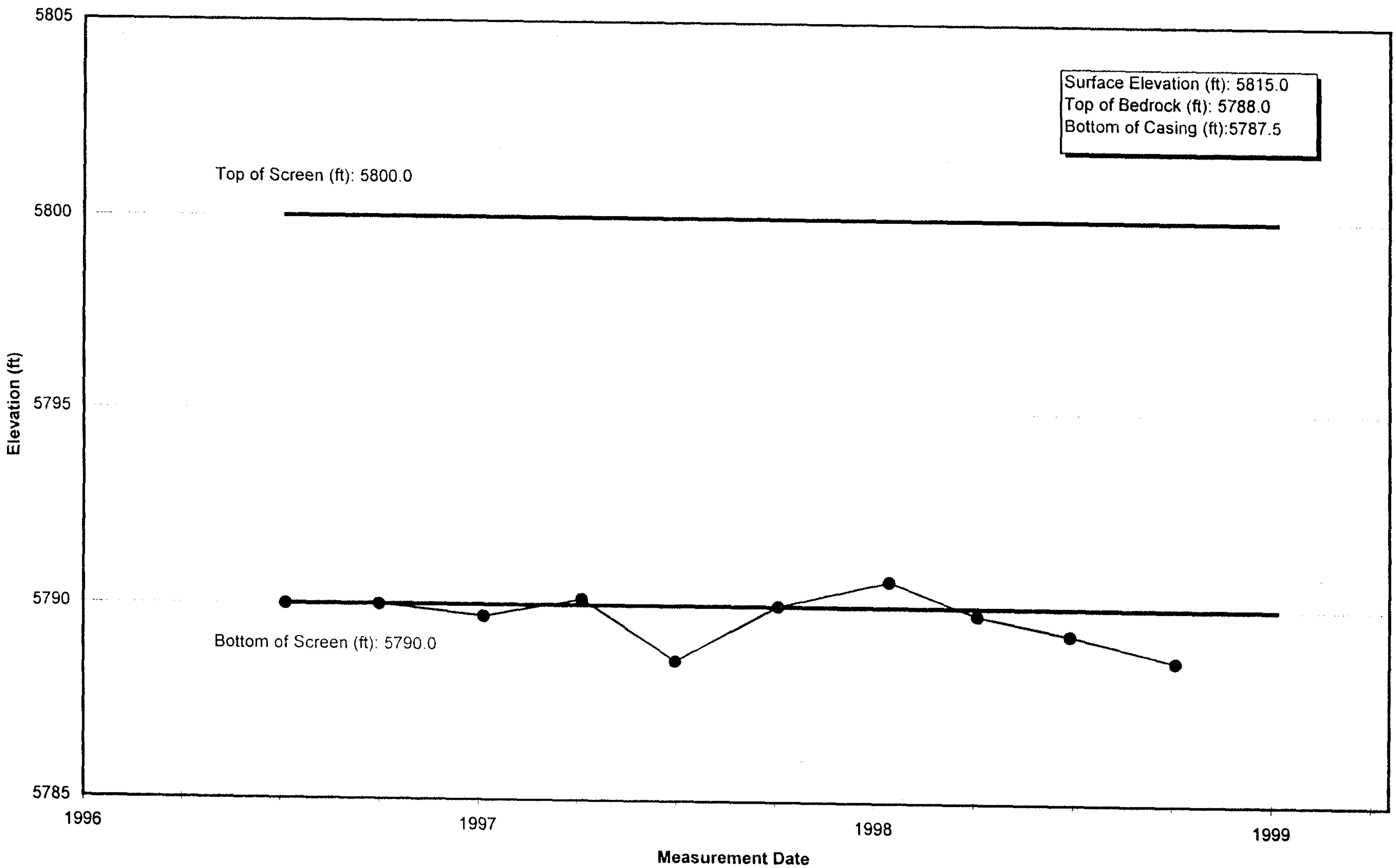


S7_97 96 9/22/99

~~303~~ 302

Hydrograph 23196



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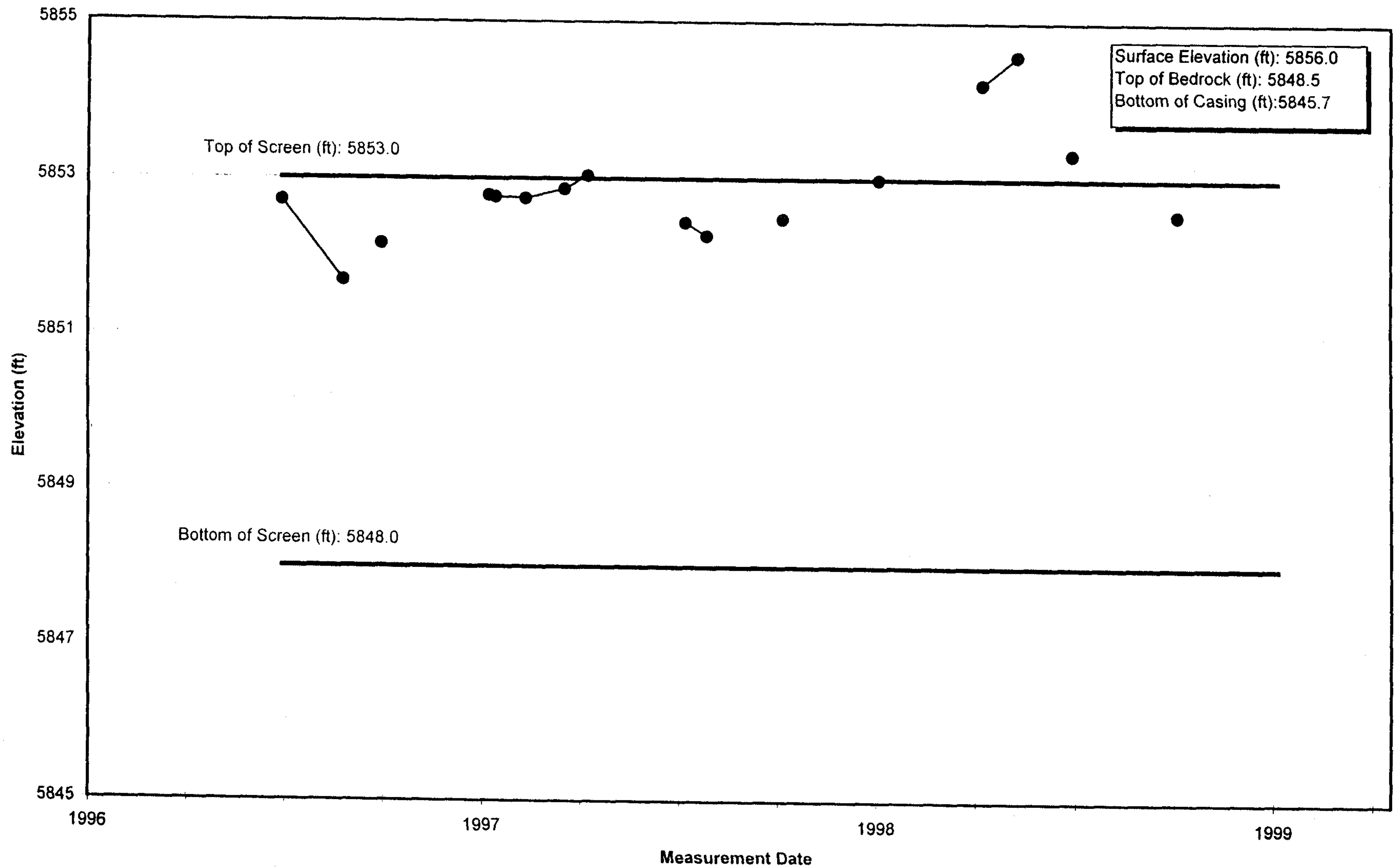
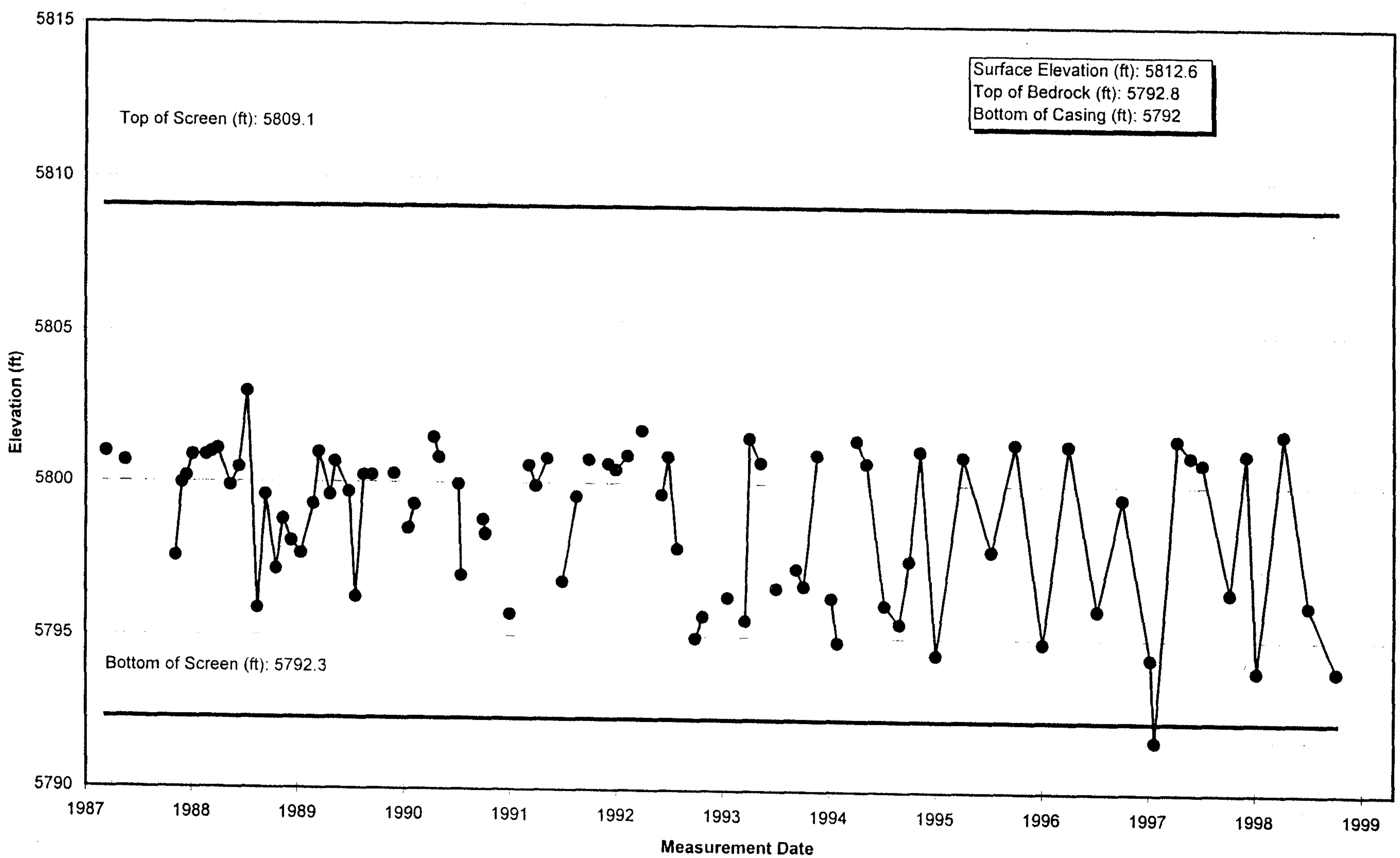
Hydrograph 23296



Hydrograph 2987



S8_97.xls 2987 9/22/99

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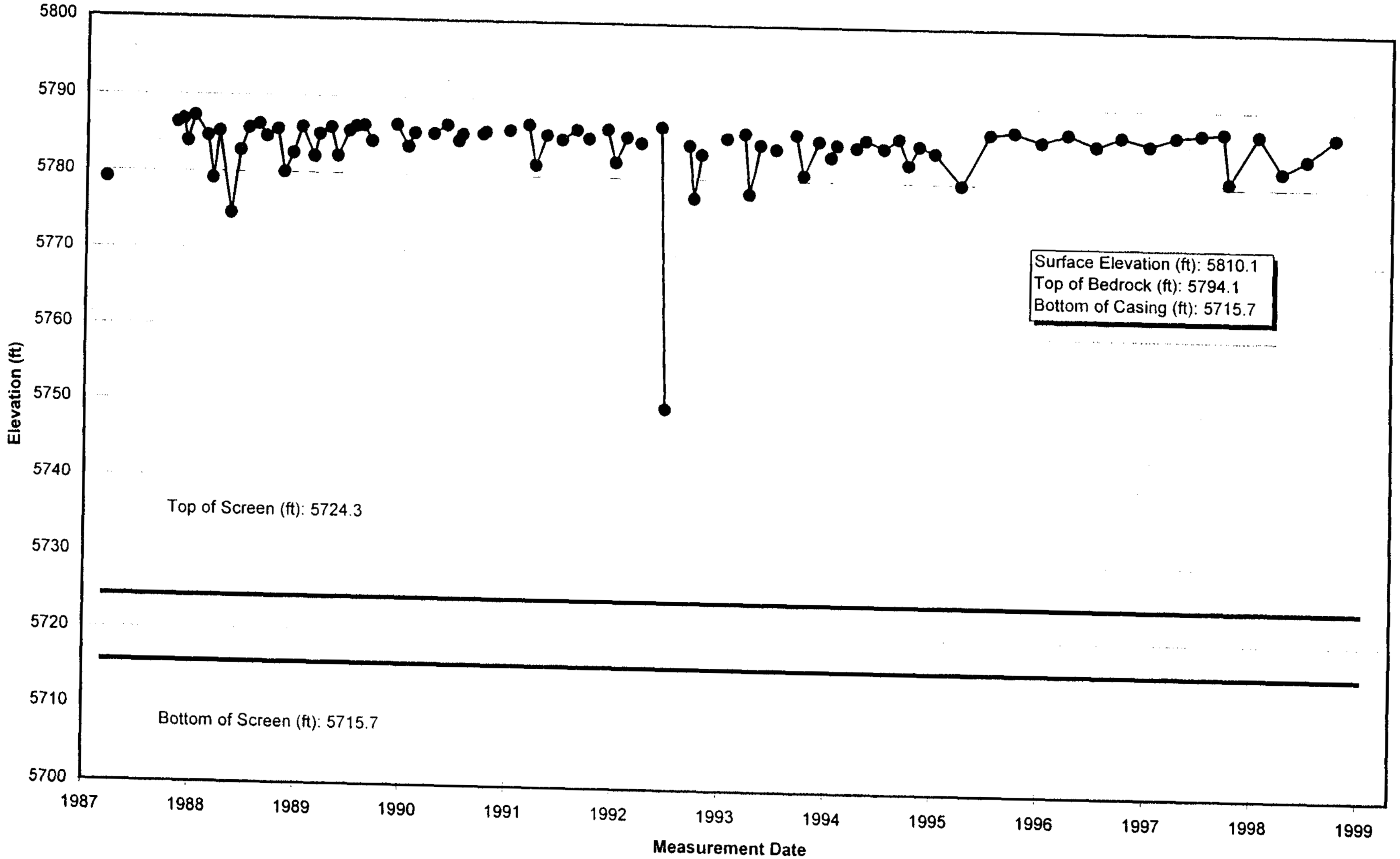
Hydrograph 3087



S8_97 7 9/22/99

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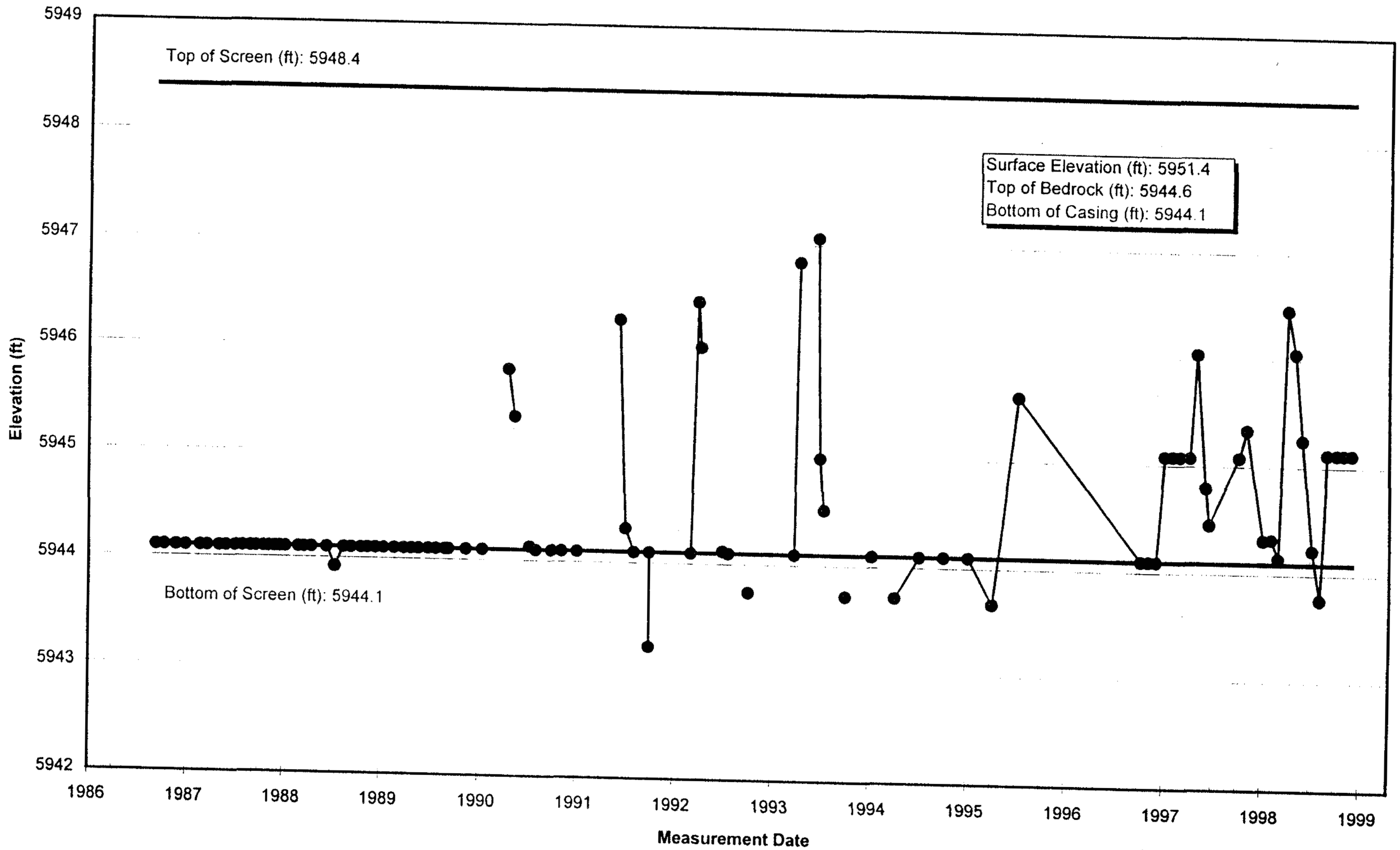
Hydrograph 3386



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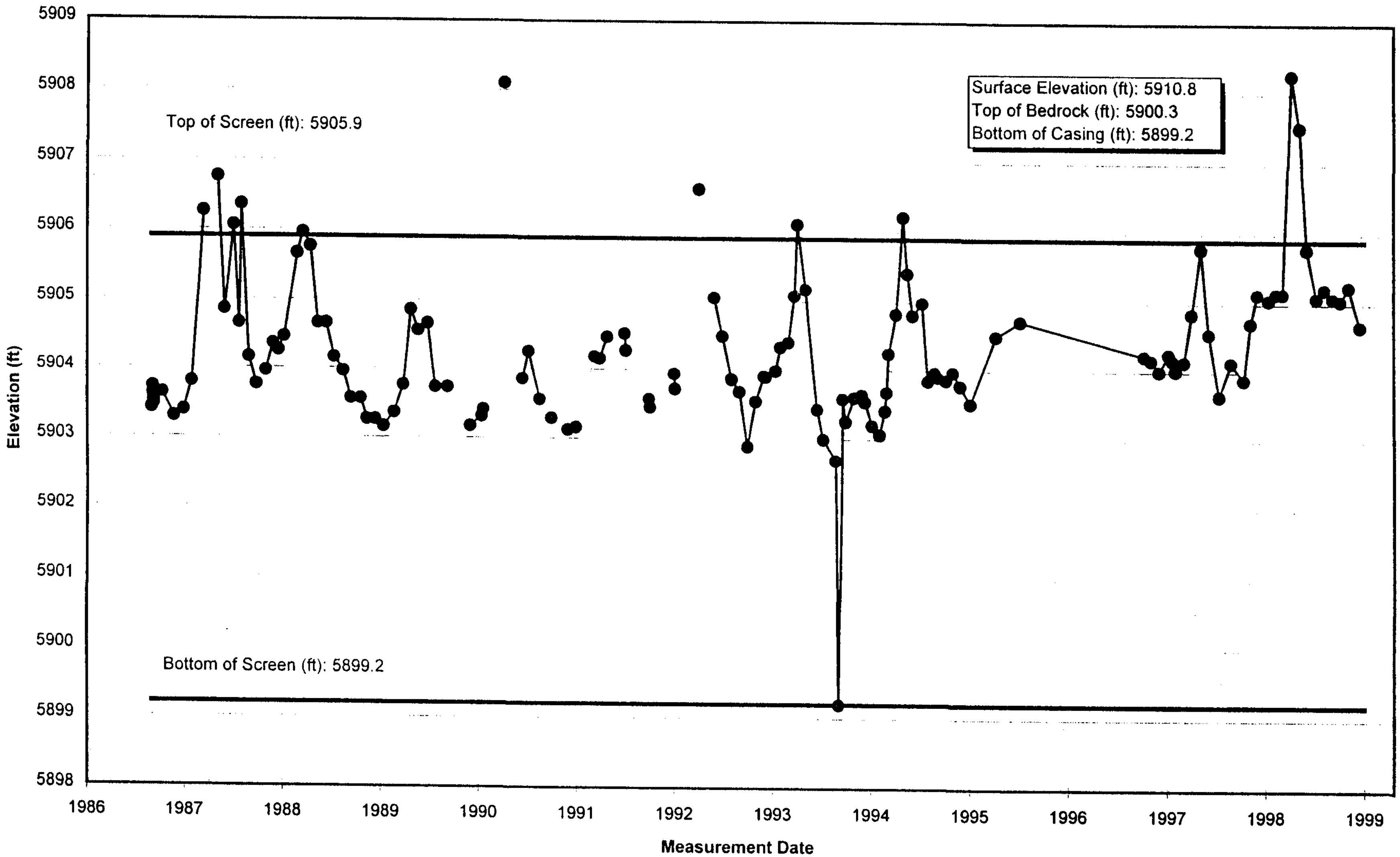
Hydrograph 3586



S9_97 9/22/99

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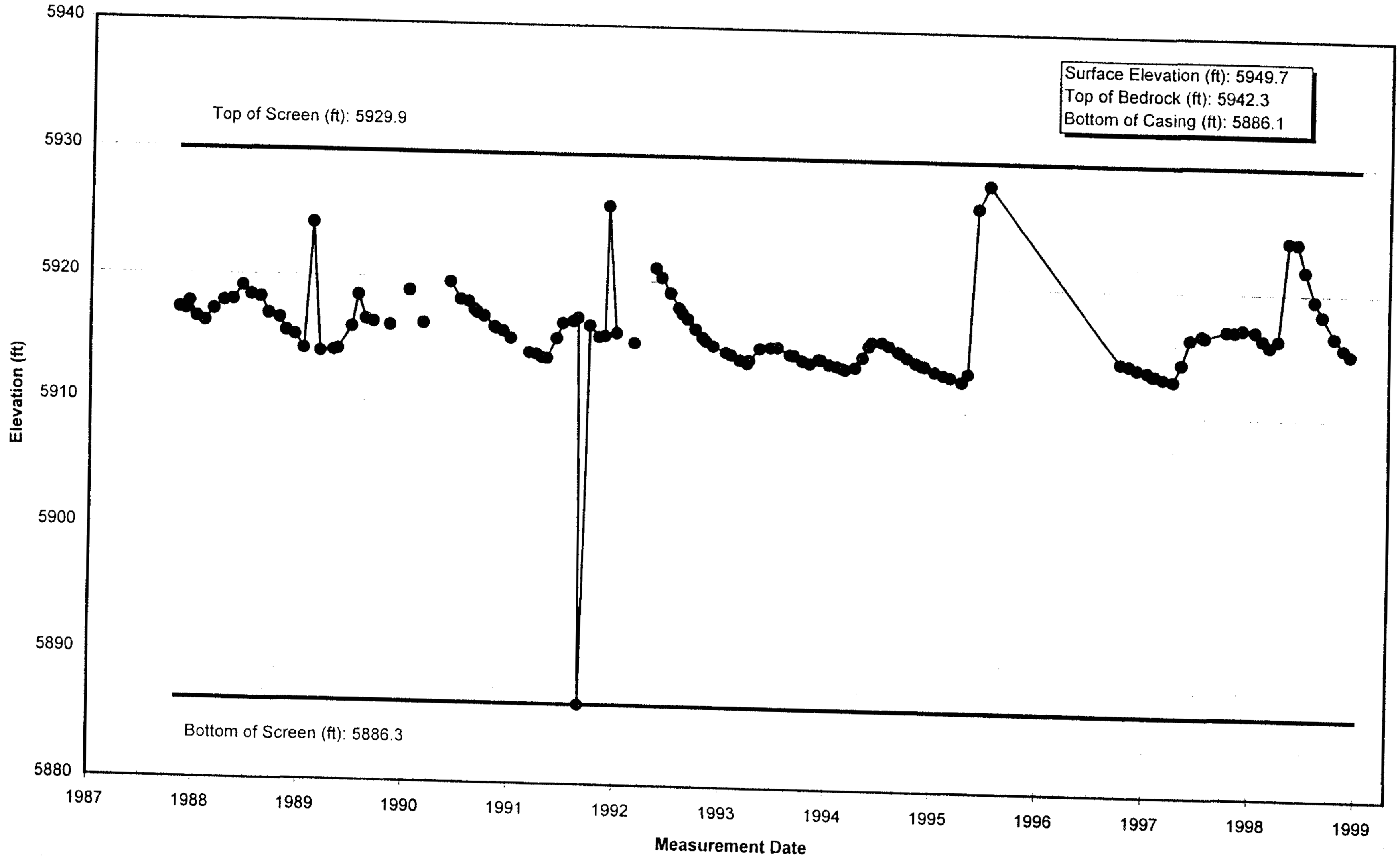
Hydrograph 3687



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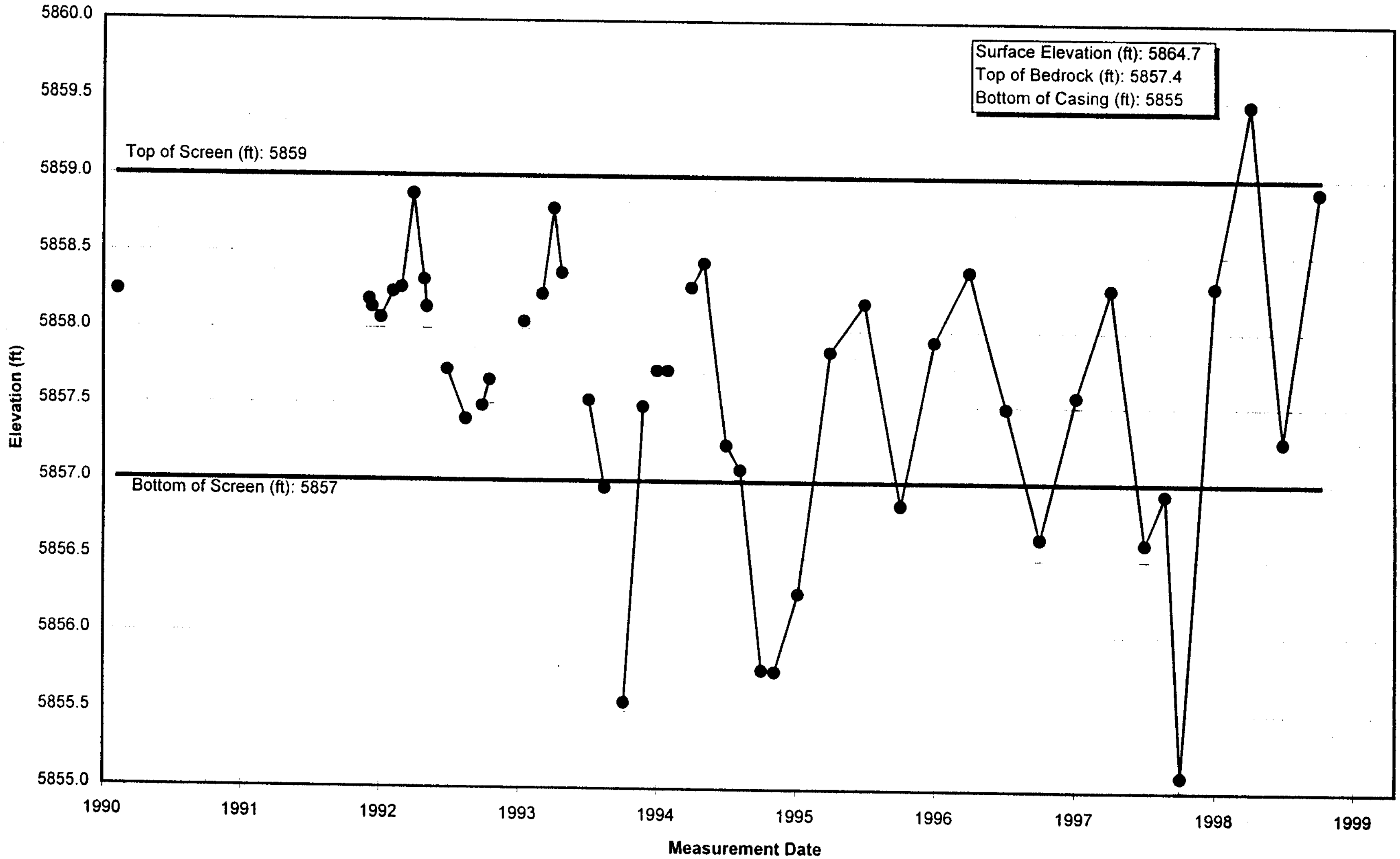
340 309

Hydrograph 38591



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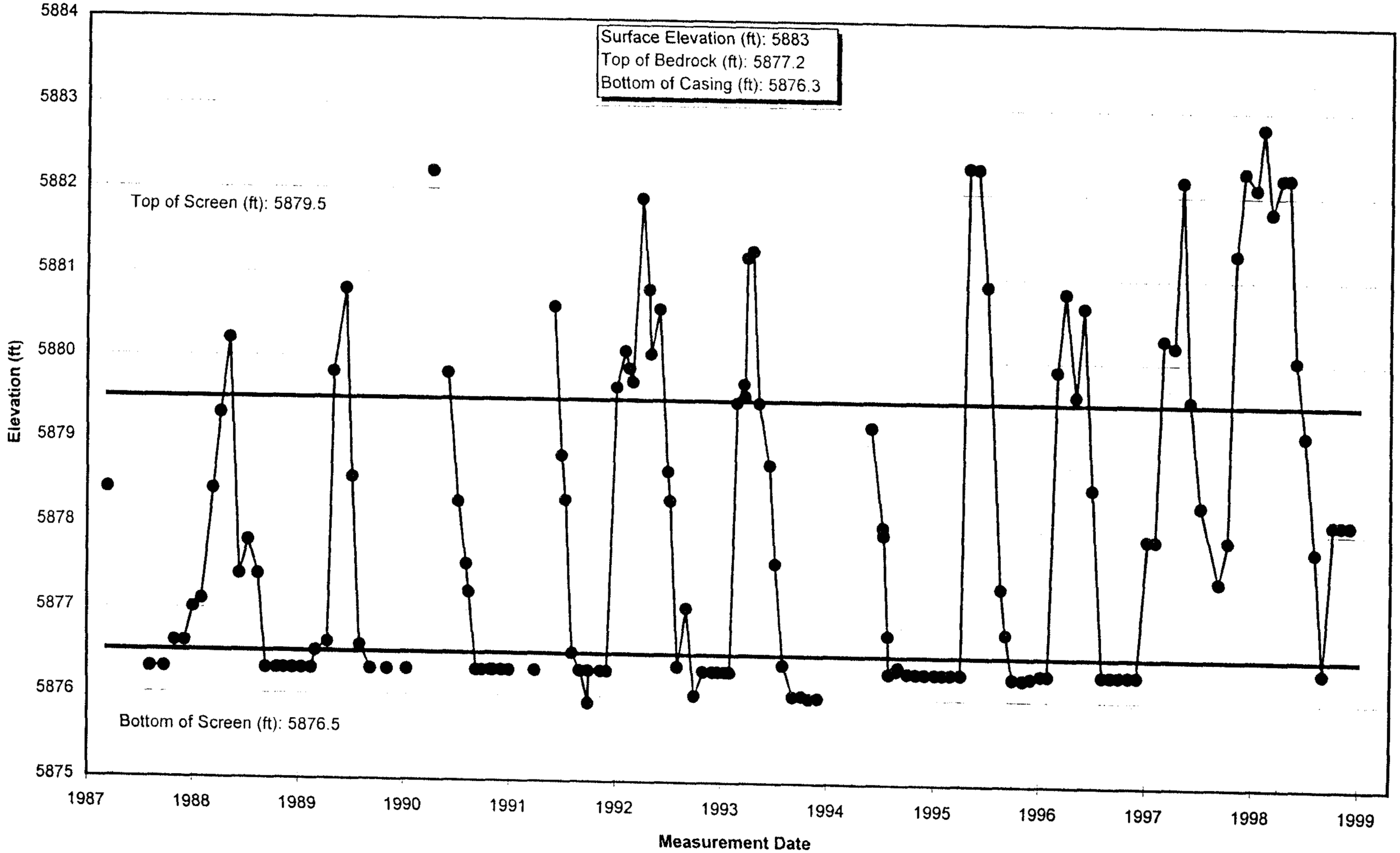
34 310

Hydrograph 4087



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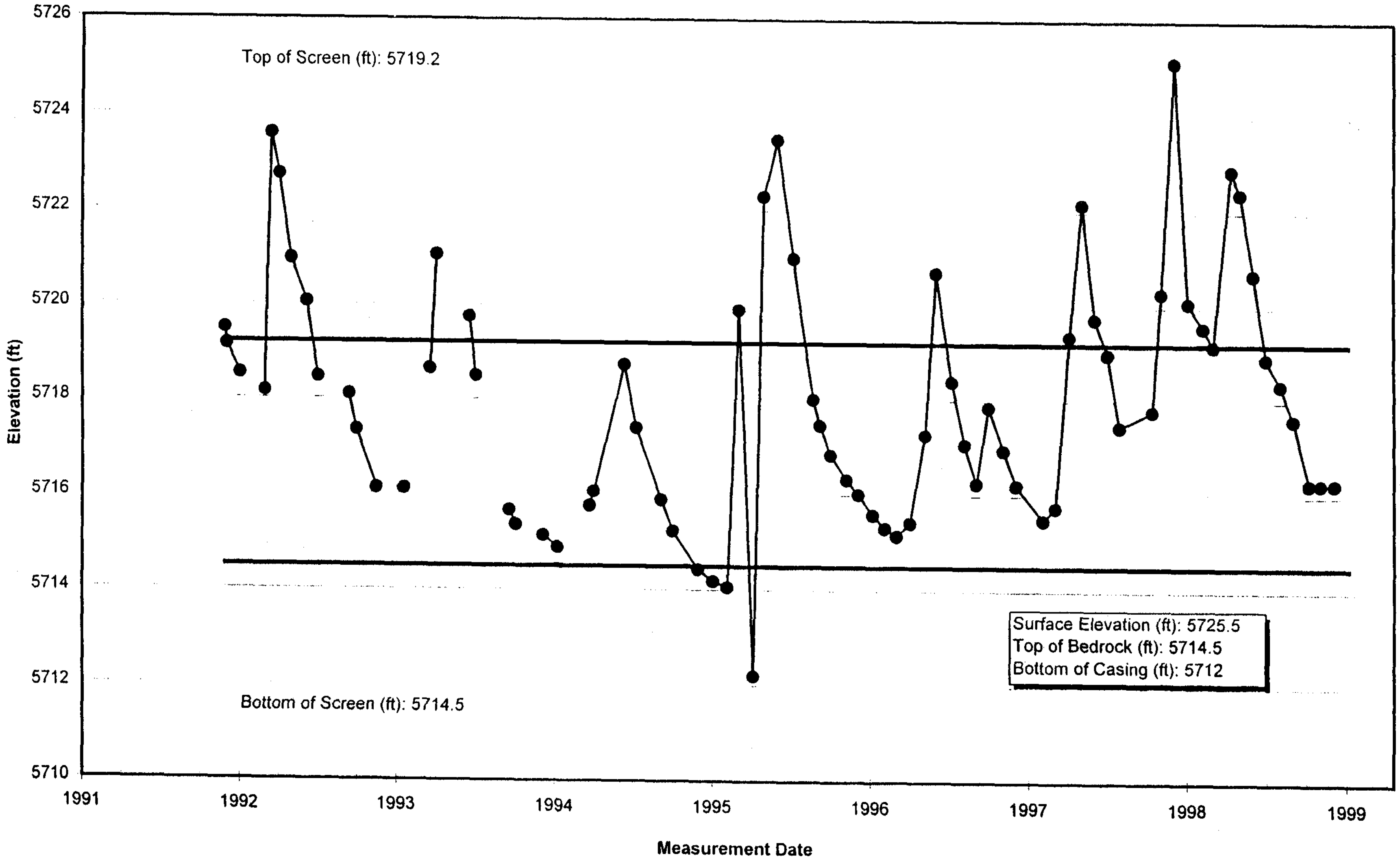
3+2 311

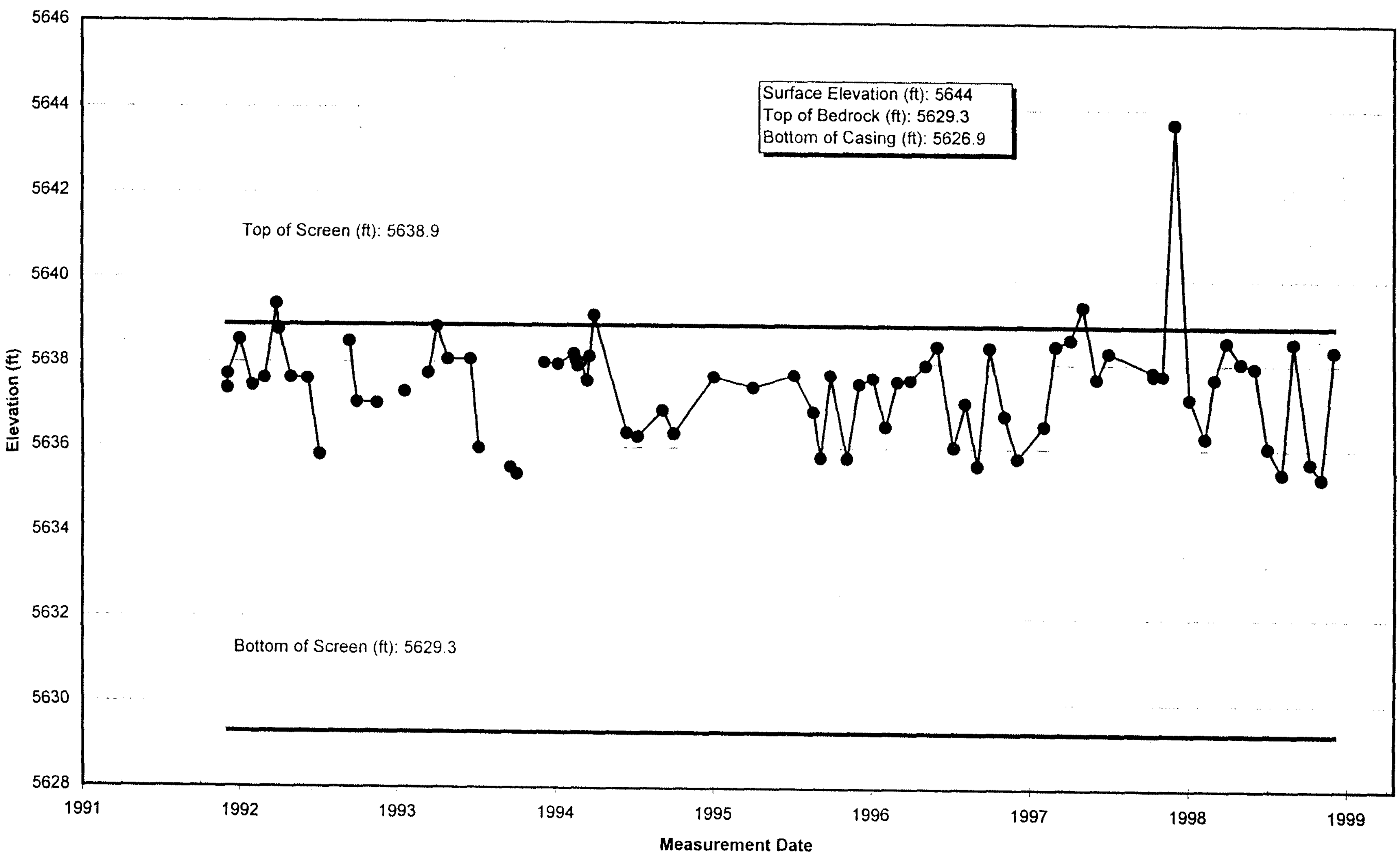
Hydrograph 41591



S11_9 91 9/22/99

~~313~~ 312

Hydrograph 41691



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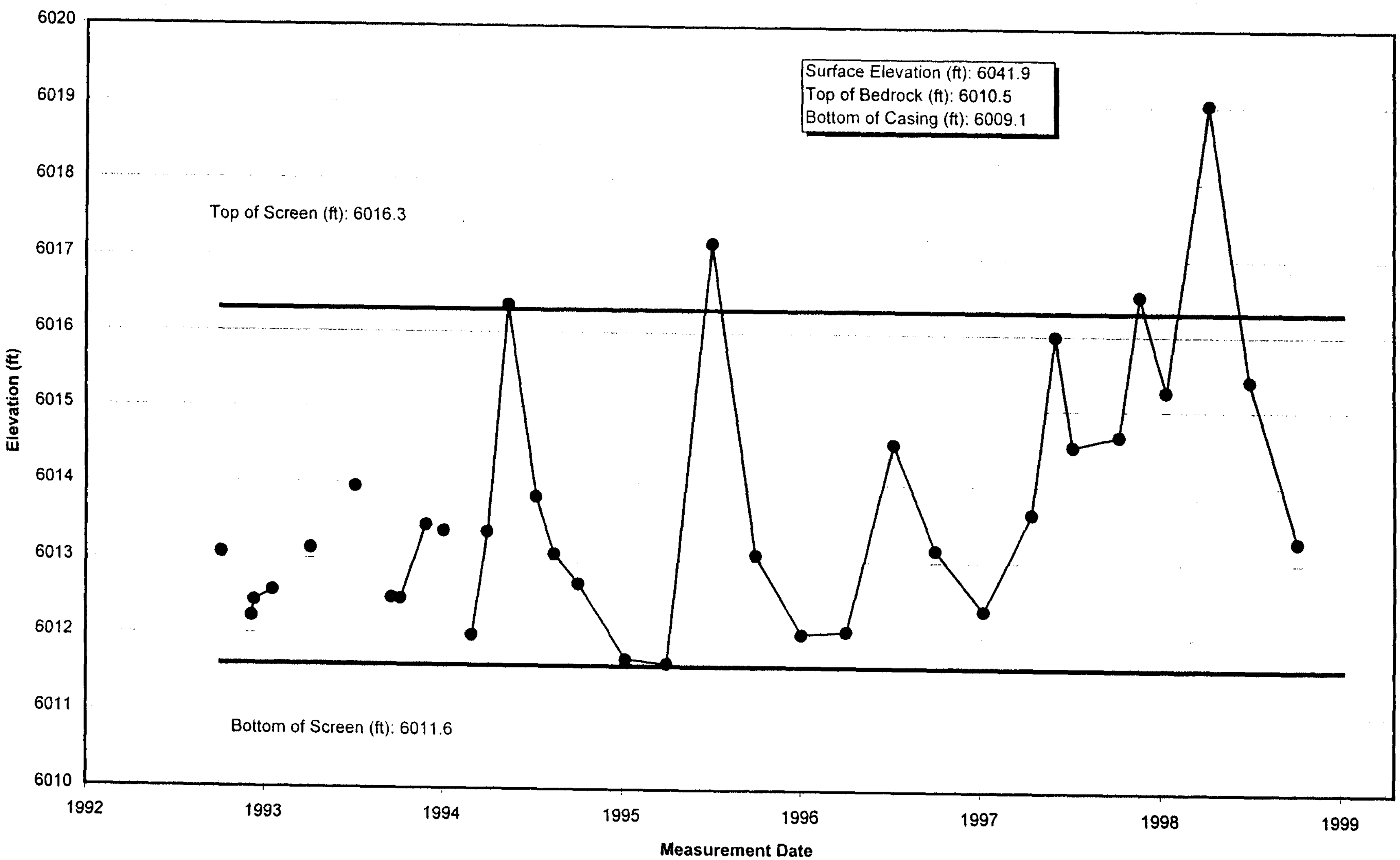
34 3/3

Hydrograph 43392



S11_97[obscured by punch hole]92 9/22/99

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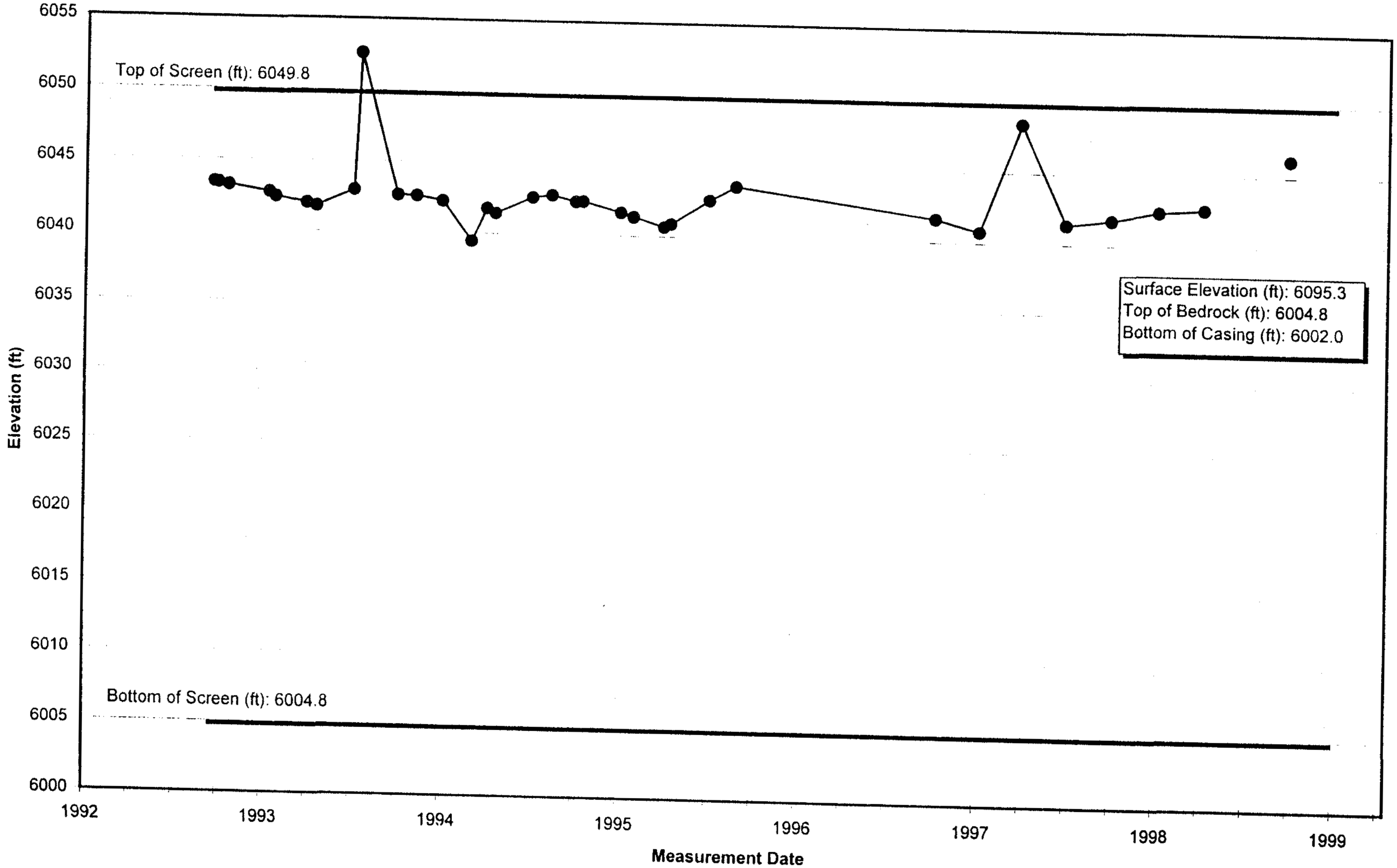
Hydrograph 46292



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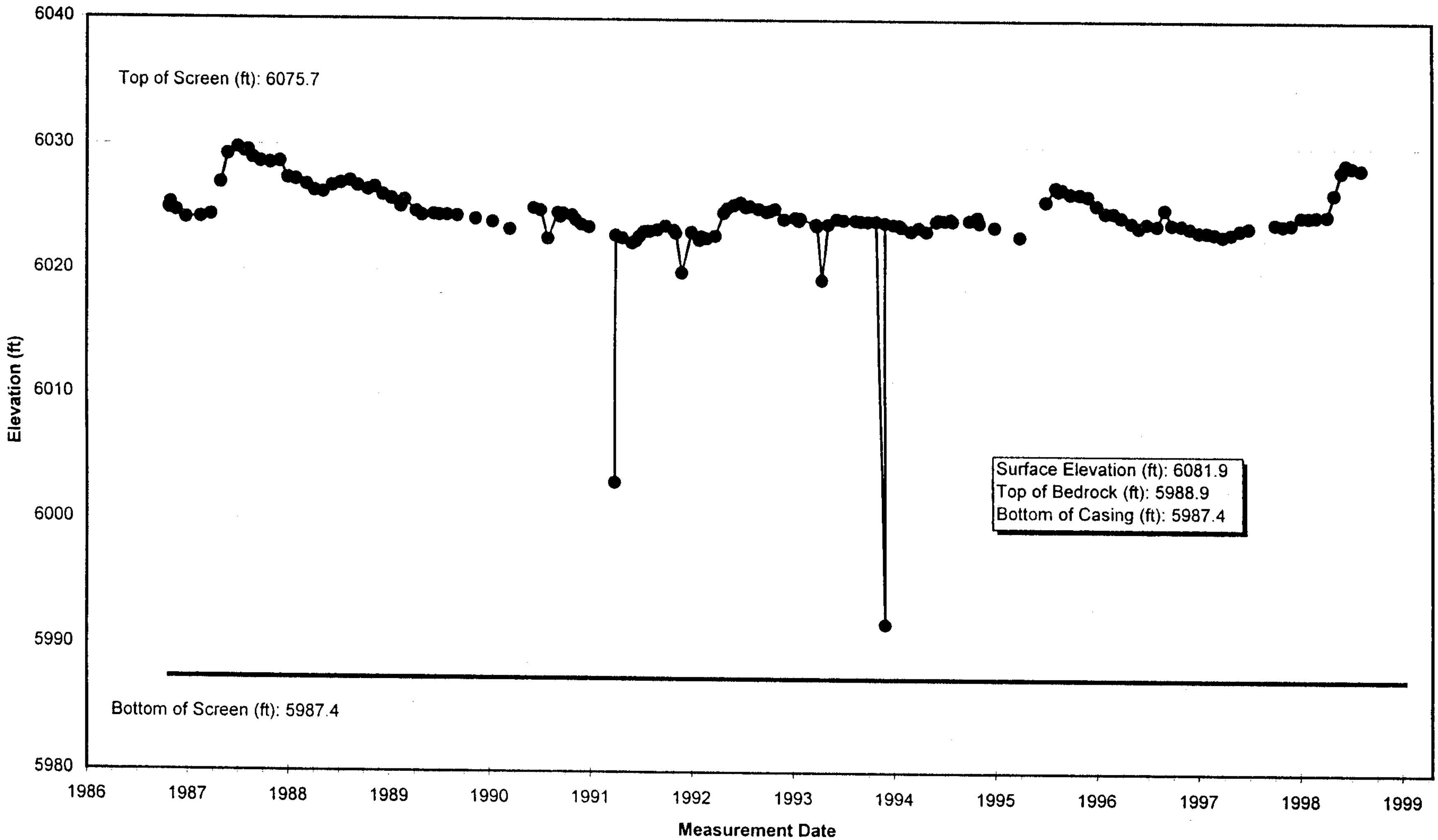
3r6 315

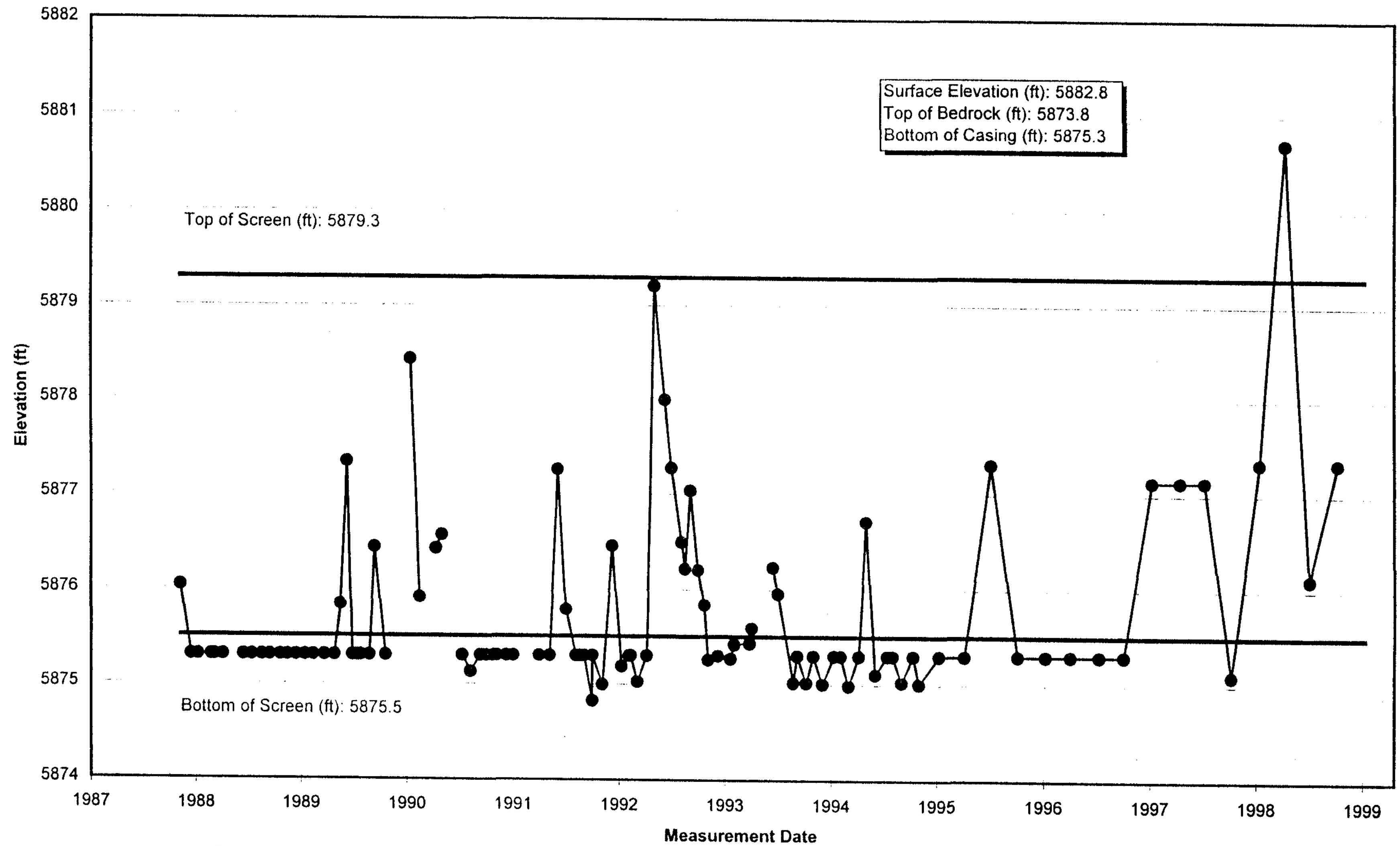
Hydrograph 4786



S13_97[illegible]86 9/22/99

~~319~~ 316

Hydrograph 4787



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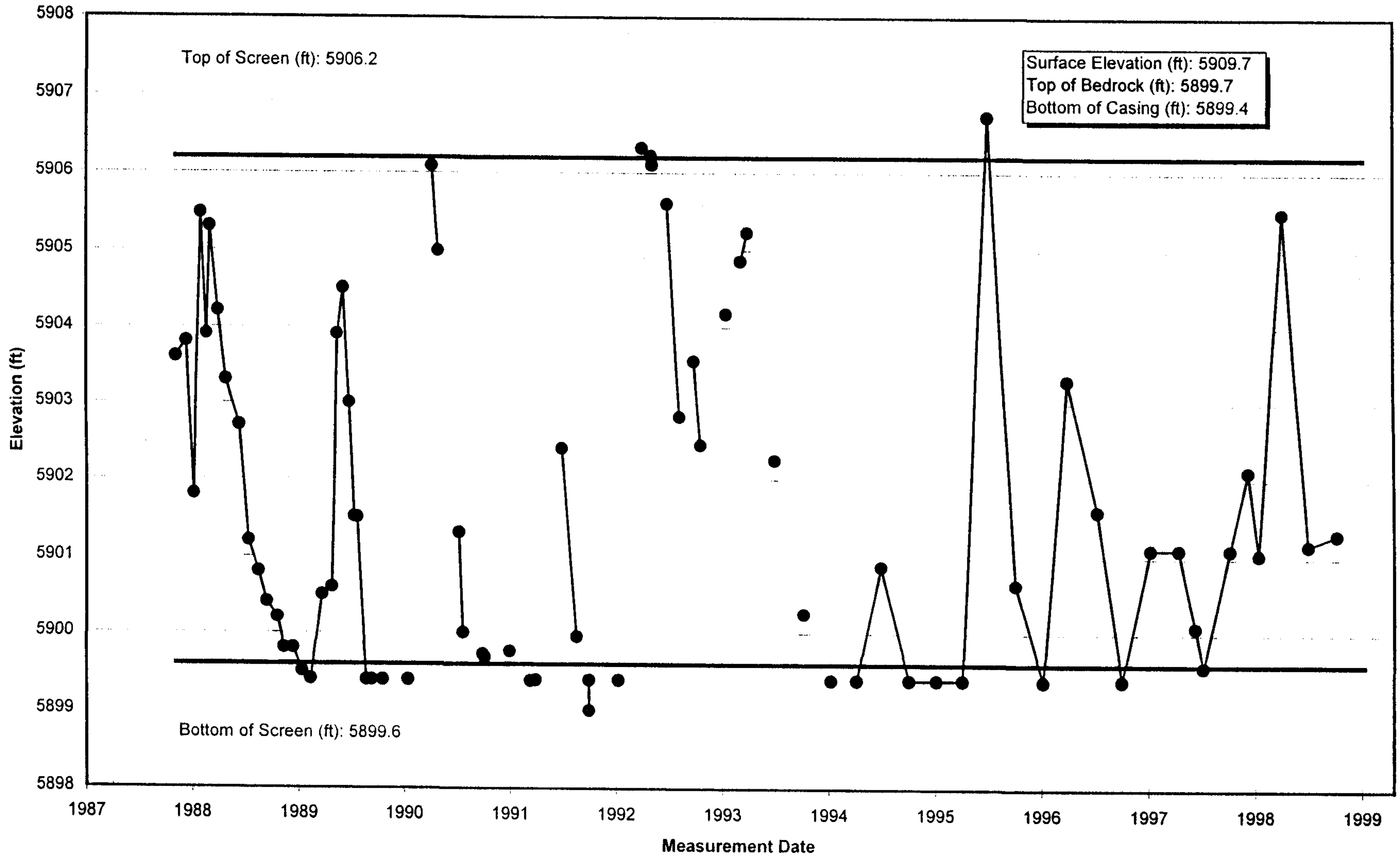
~~318~~ 317

Hydrograph 4887



S13_97 87 9/22/99

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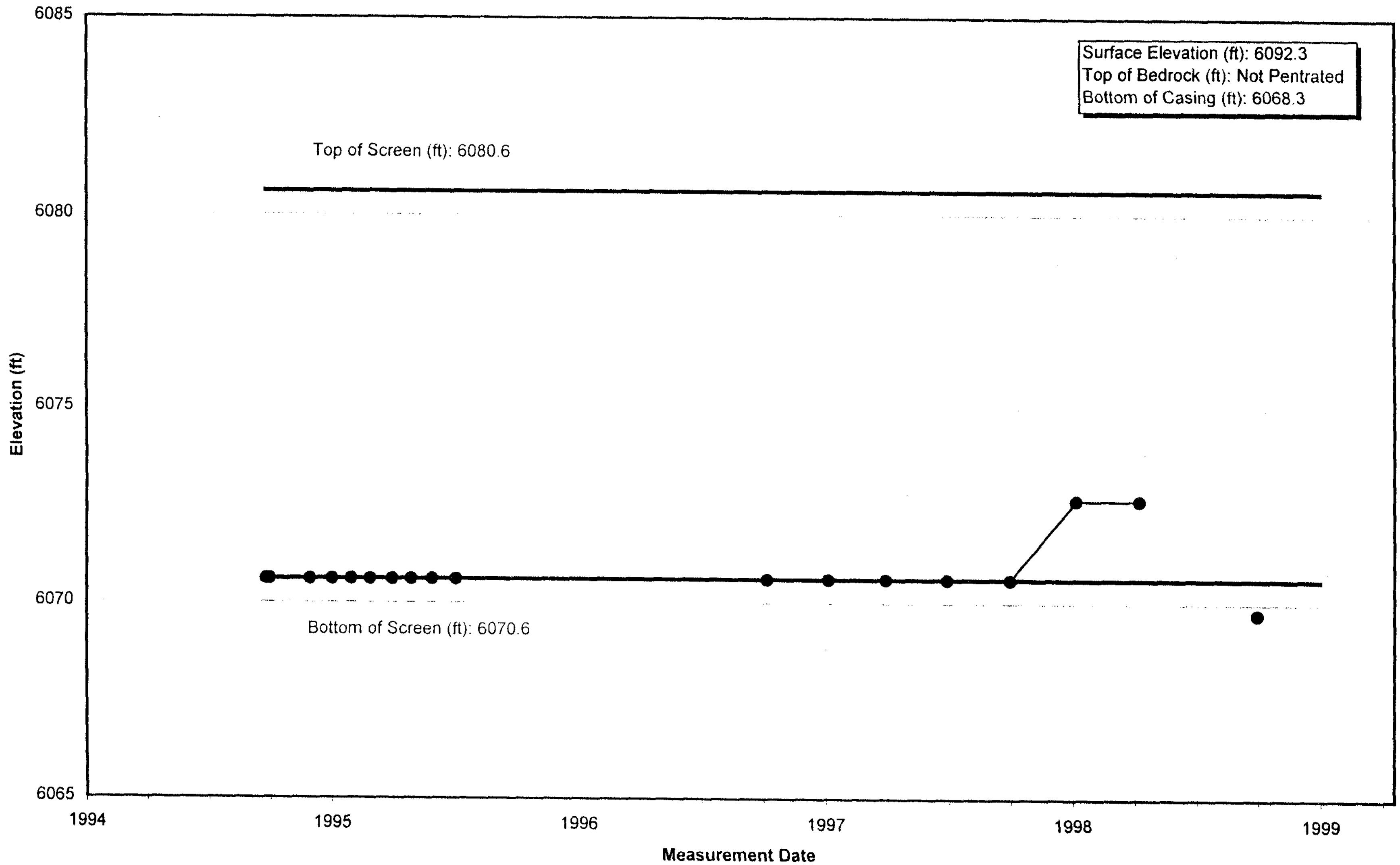
Hydrograph 50494



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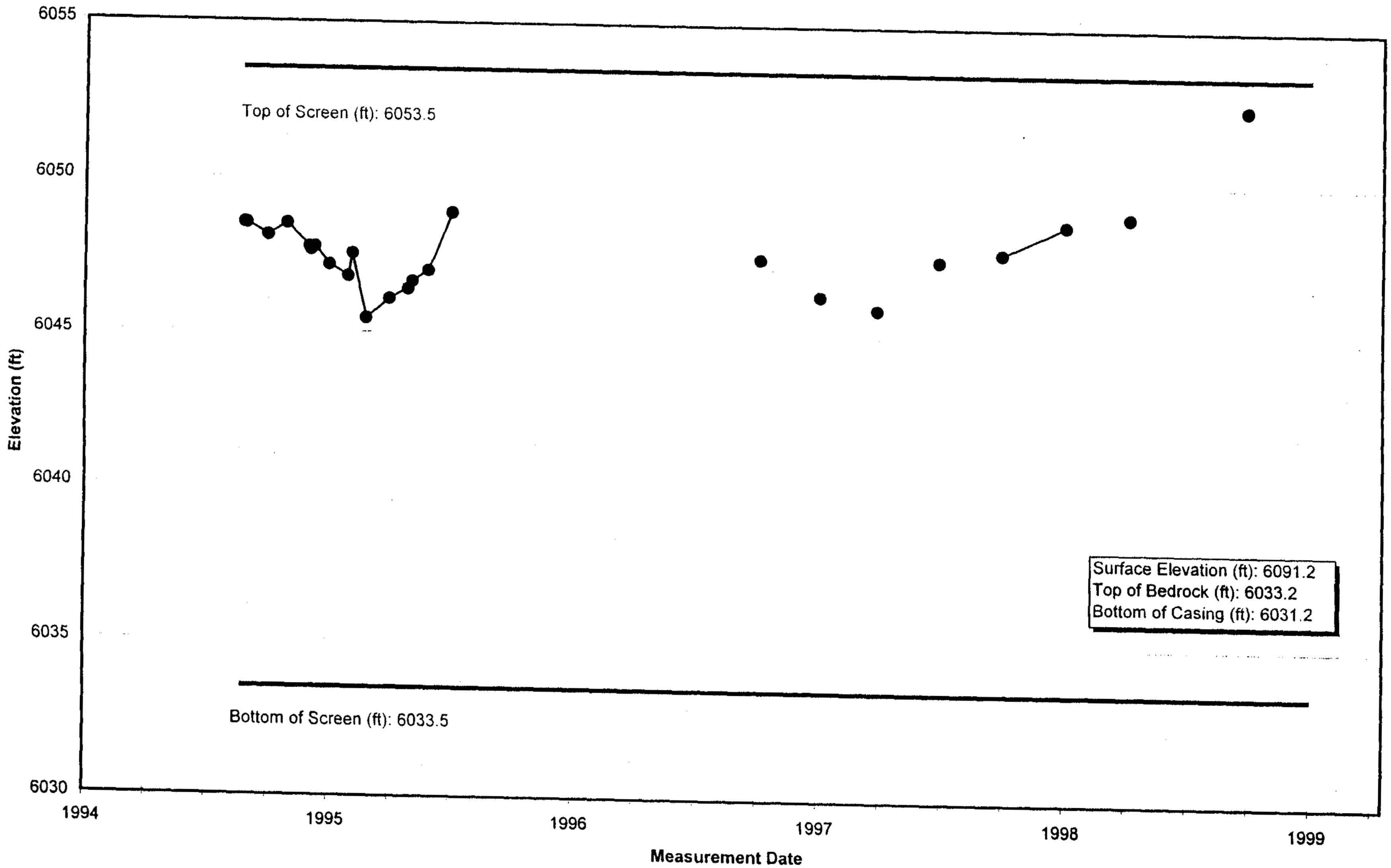
Hydrograph 51094



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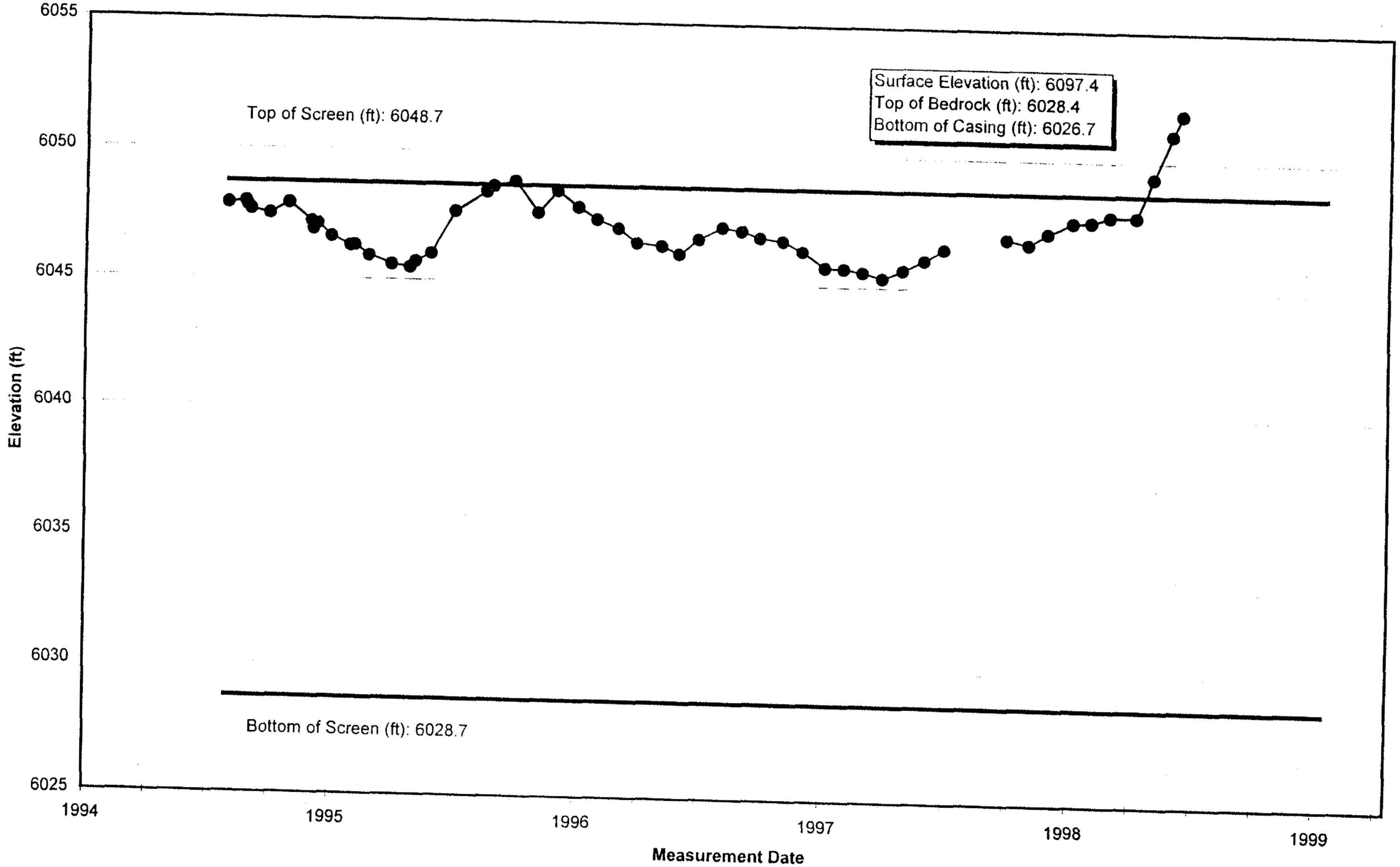

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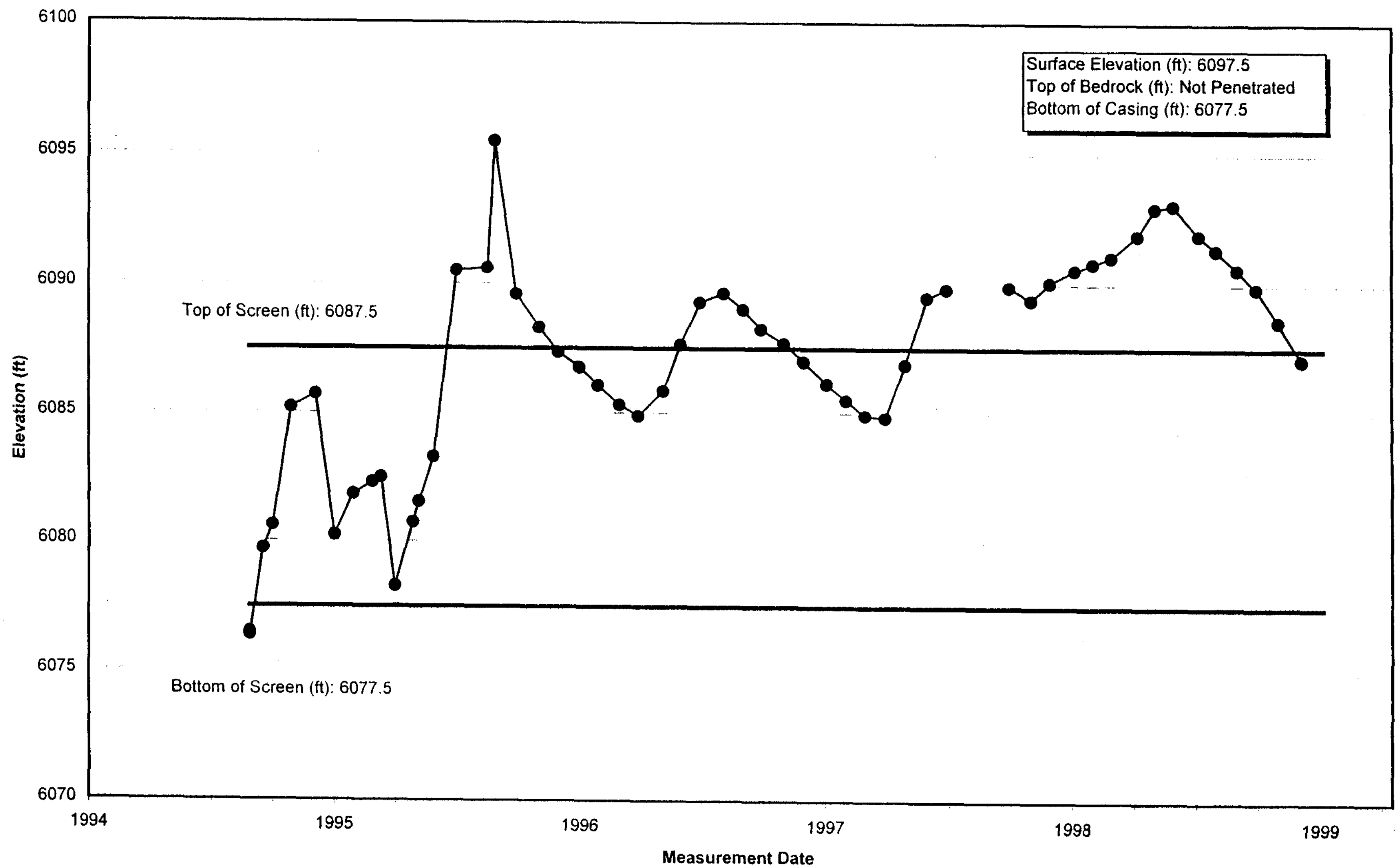
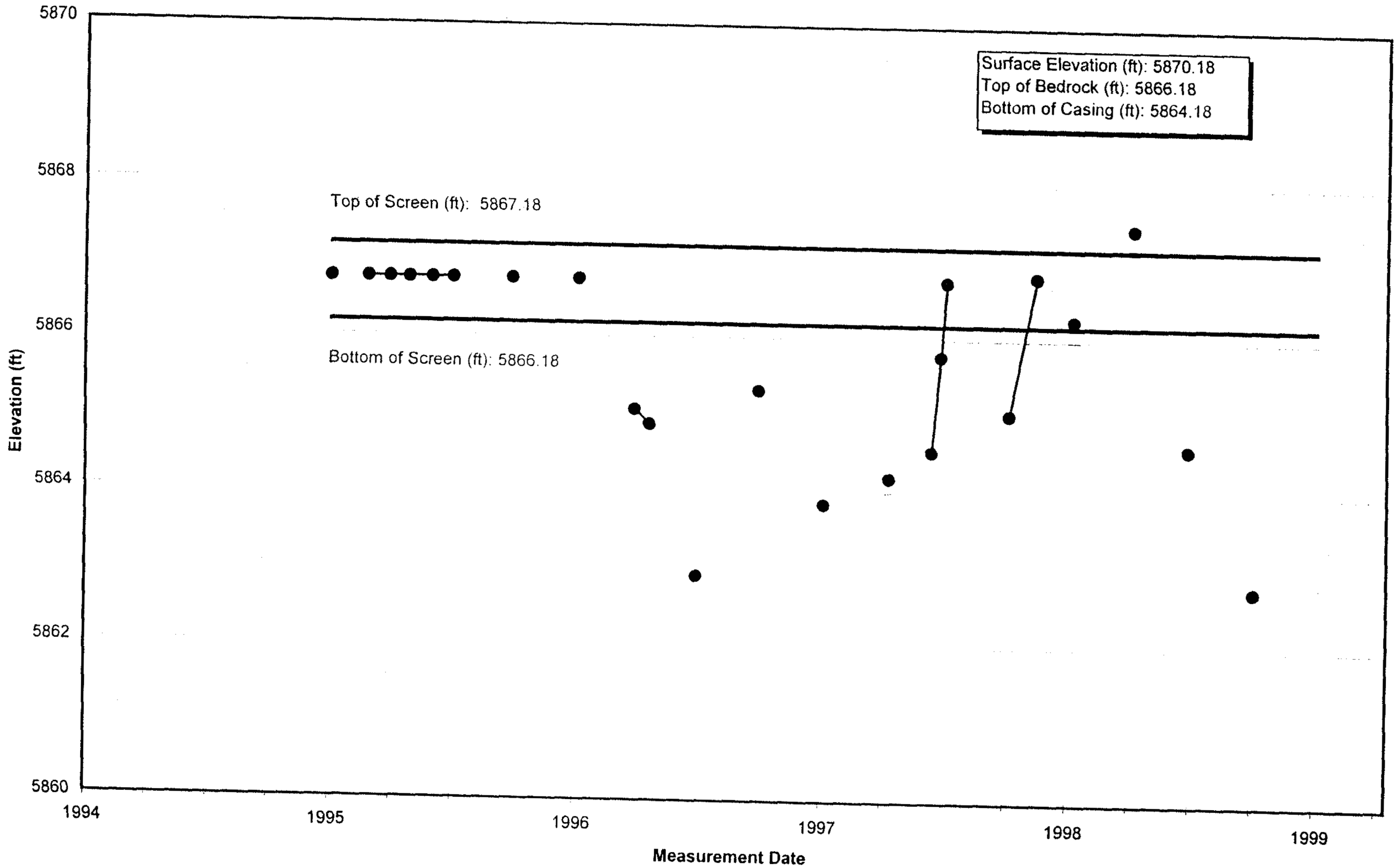
Hydrograph 51594



Hydrograph 52894



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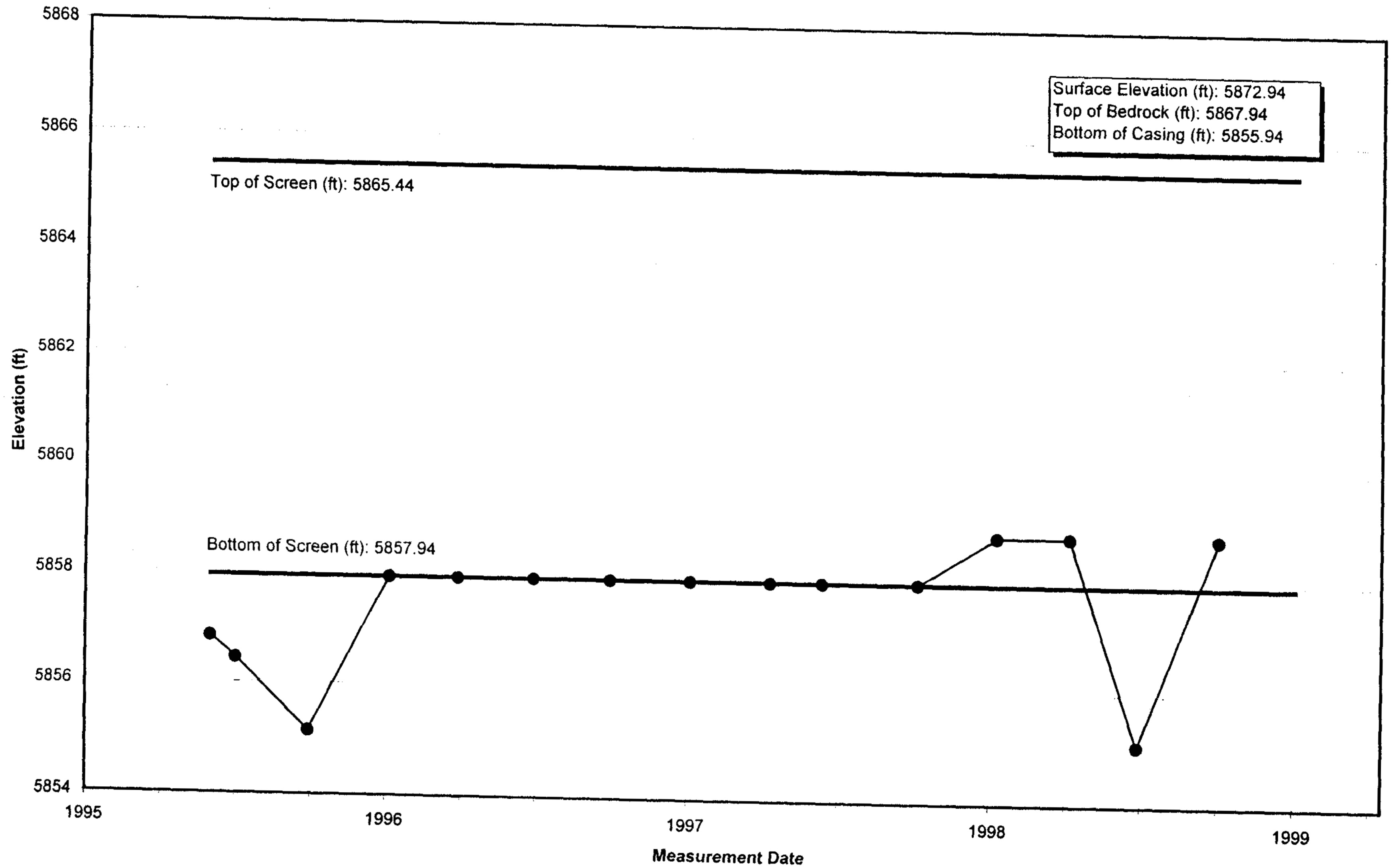
323
324

Hydrograph 52994



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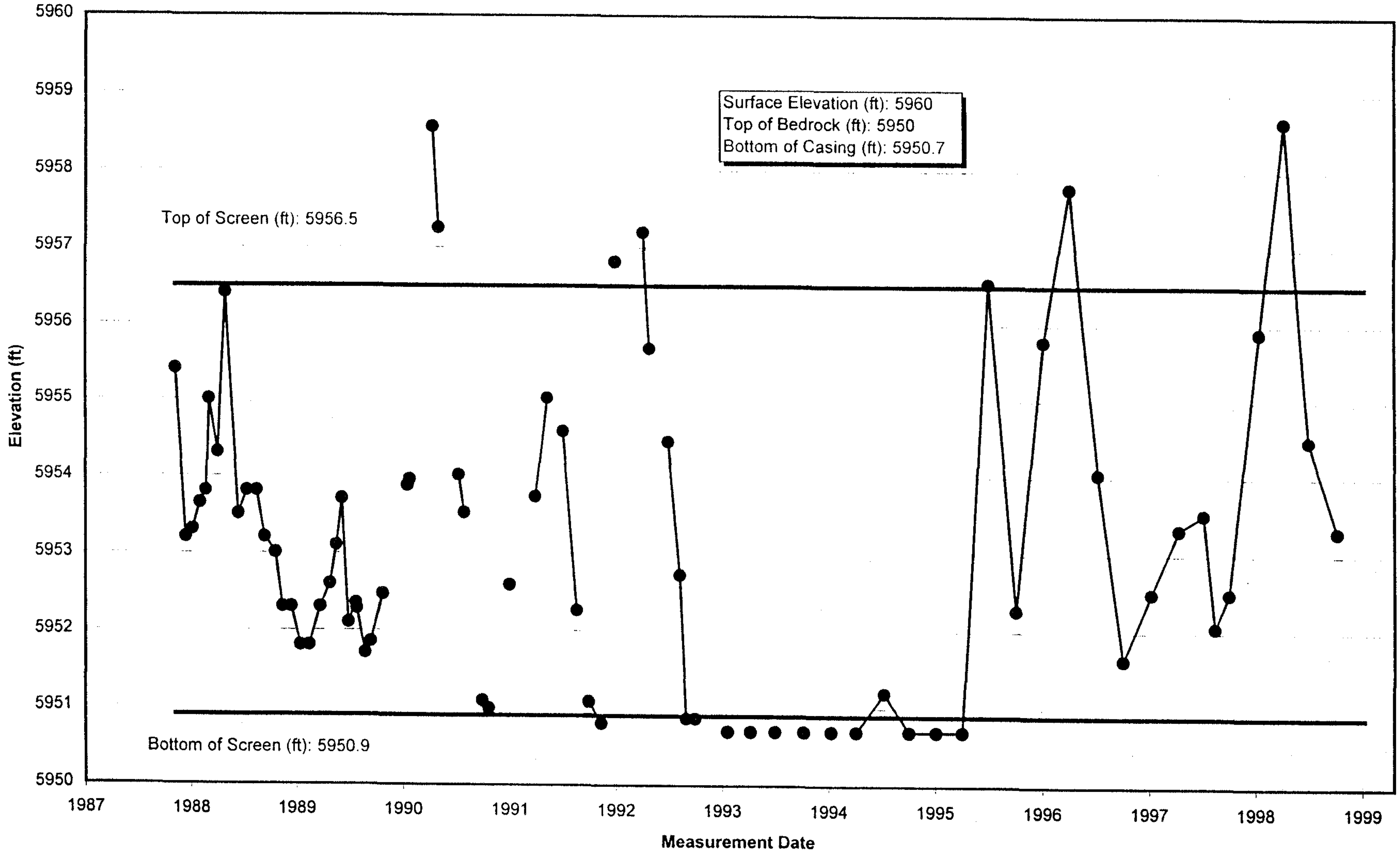
Hydrograph 5387



325
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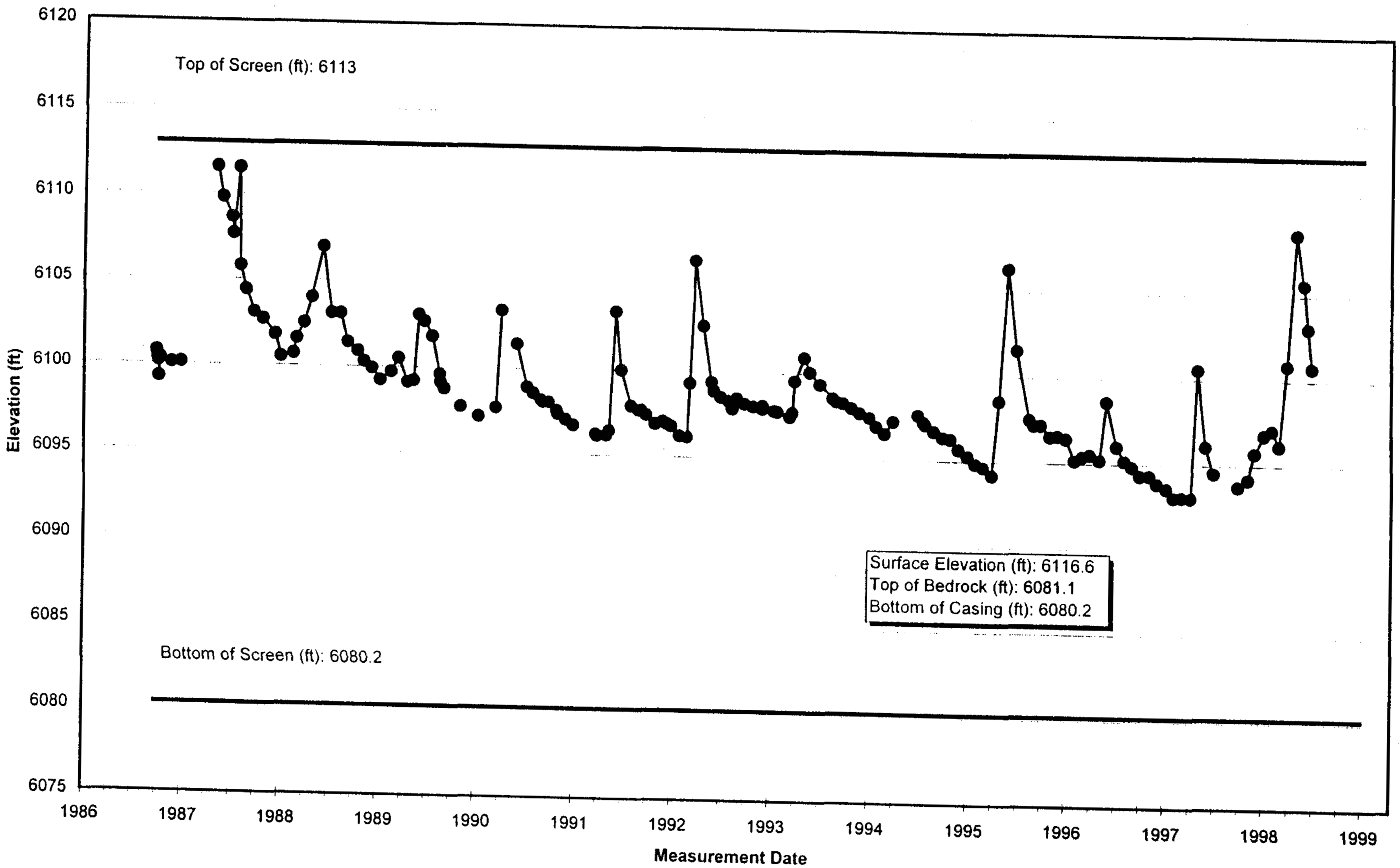
Hydrograph 5586



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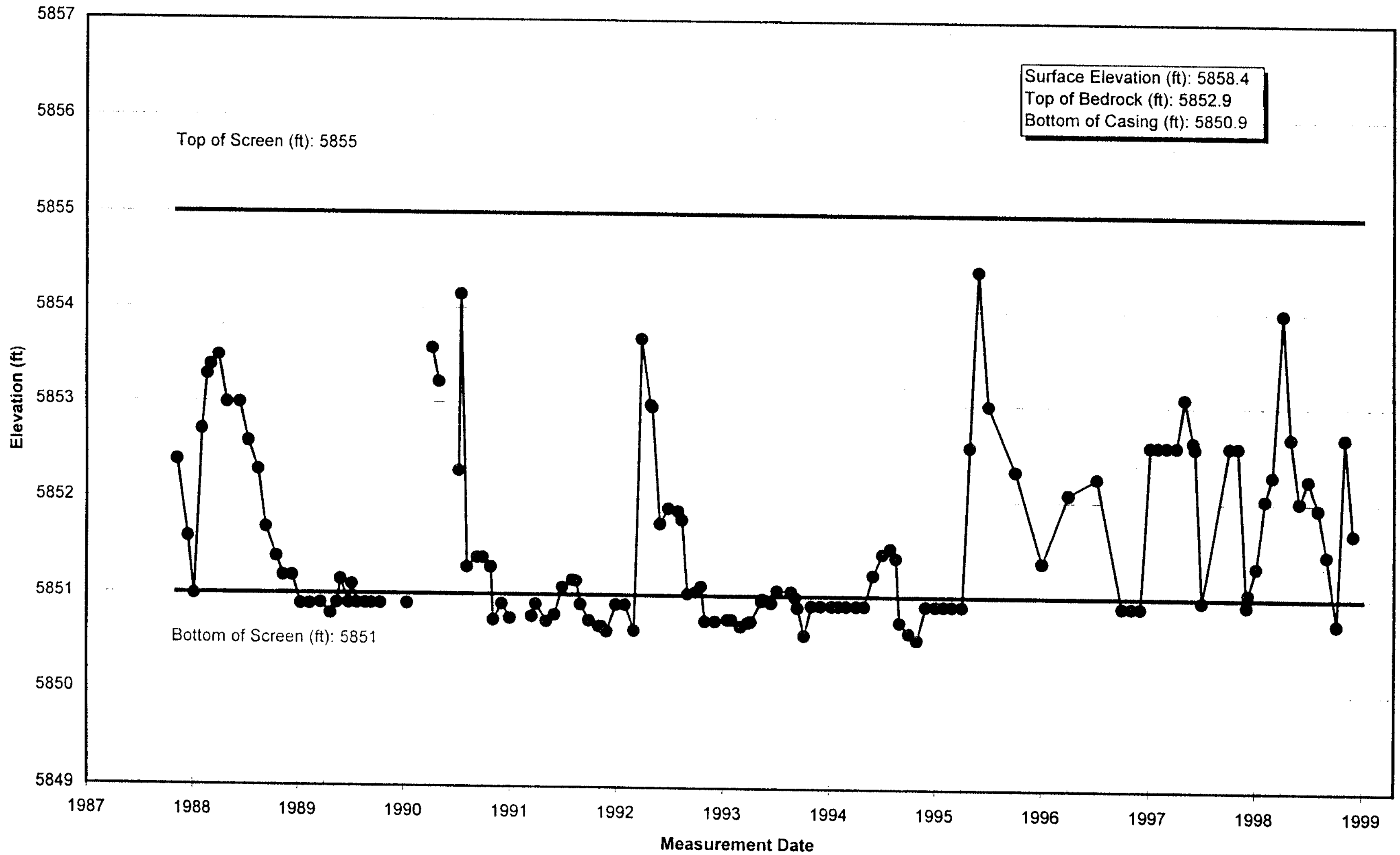
S13_97 86 9/22/99

Hydrograph 5587



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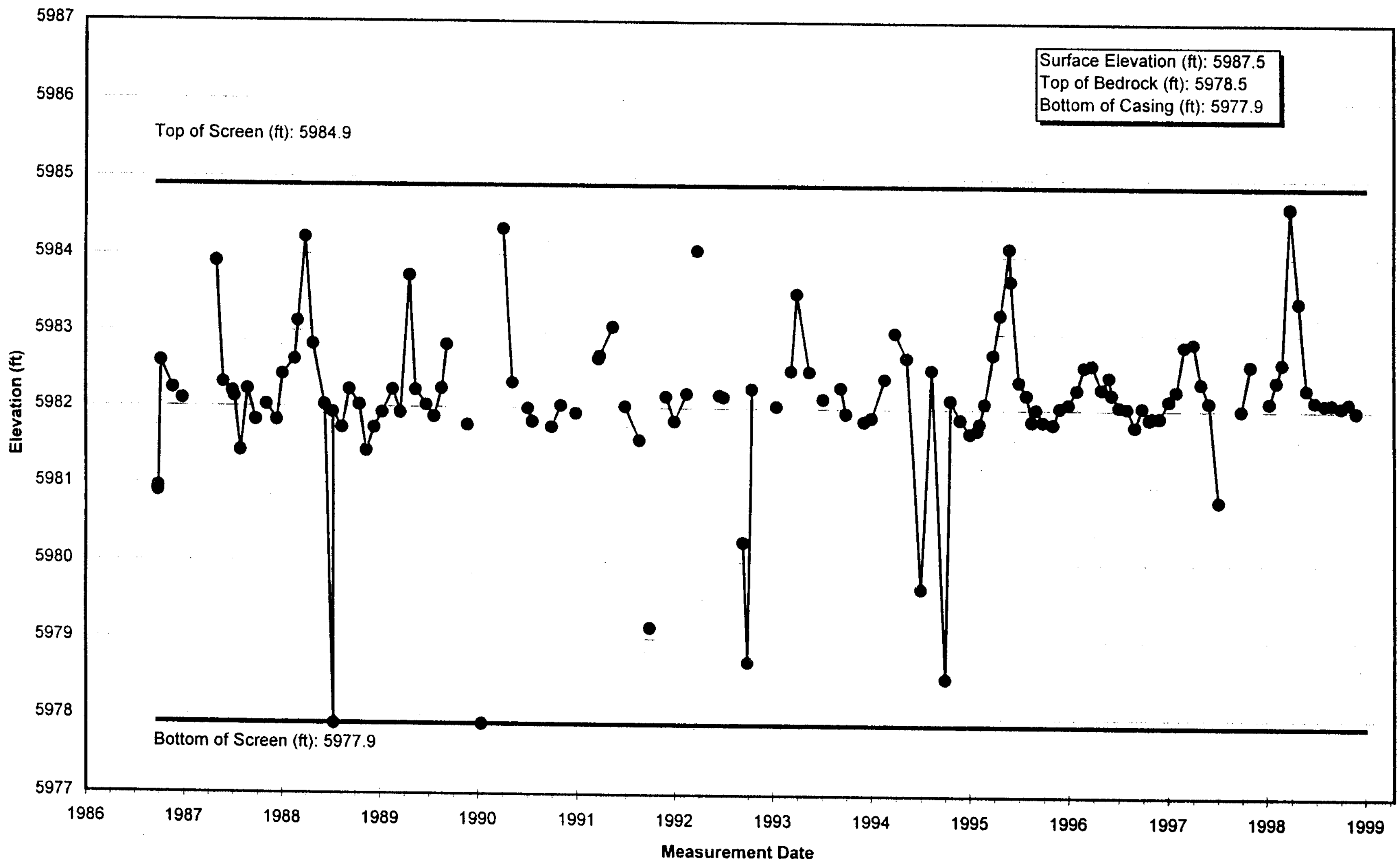
329
328

Hydrograph 5686



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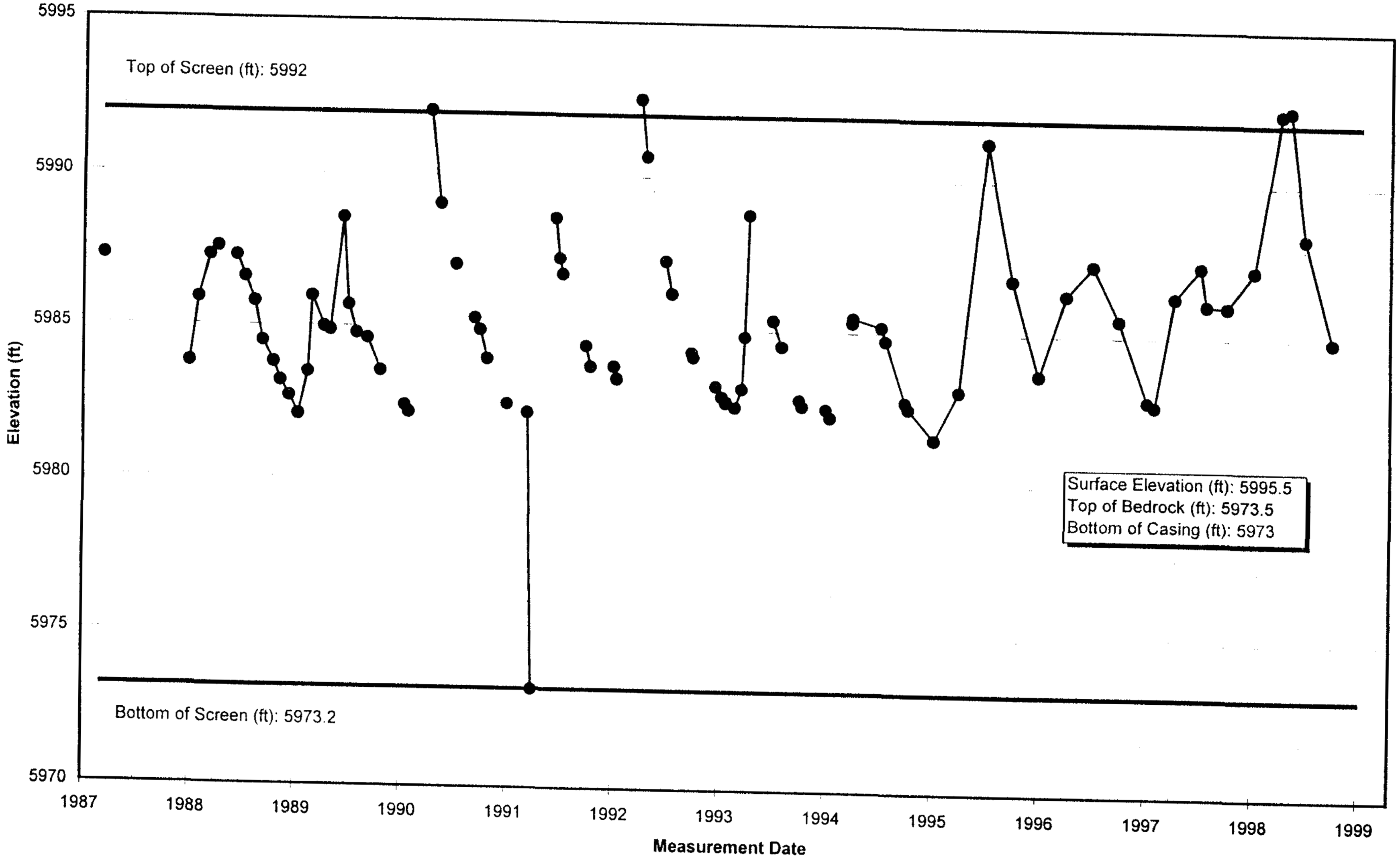
S13_97 86 9/22/99

Hydrograph 5887



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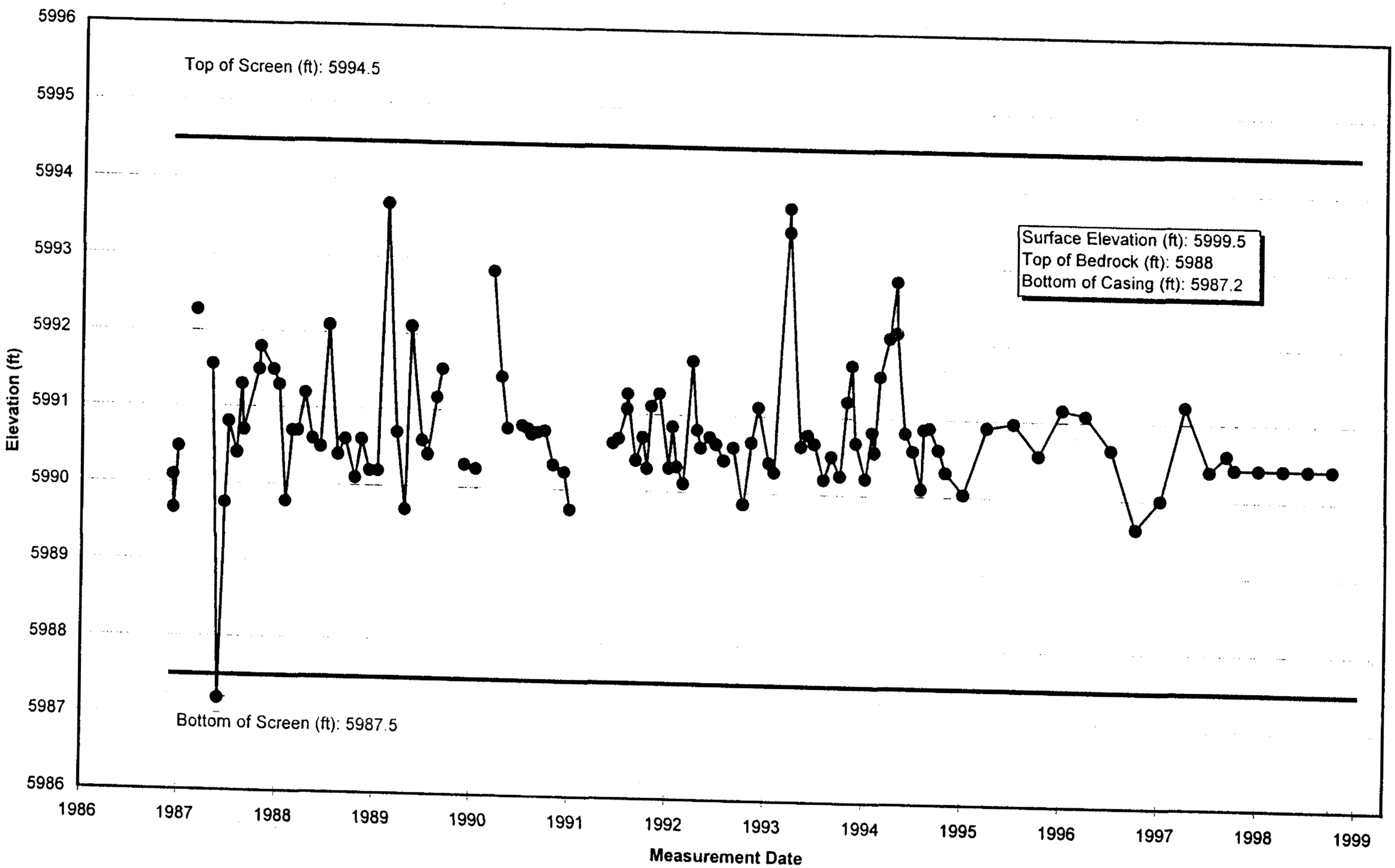
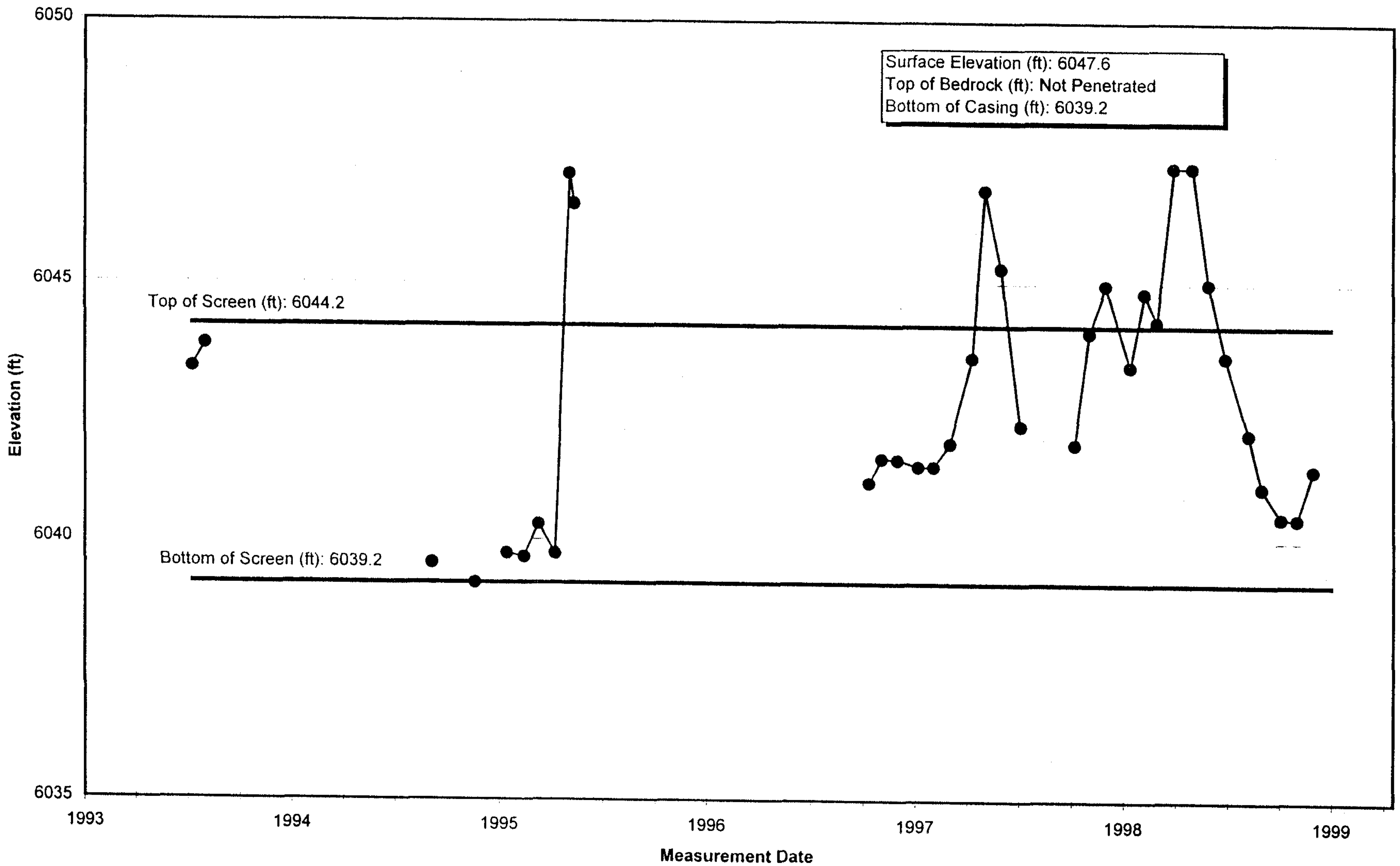
Hydrograph 6186



Hydrograph 62593



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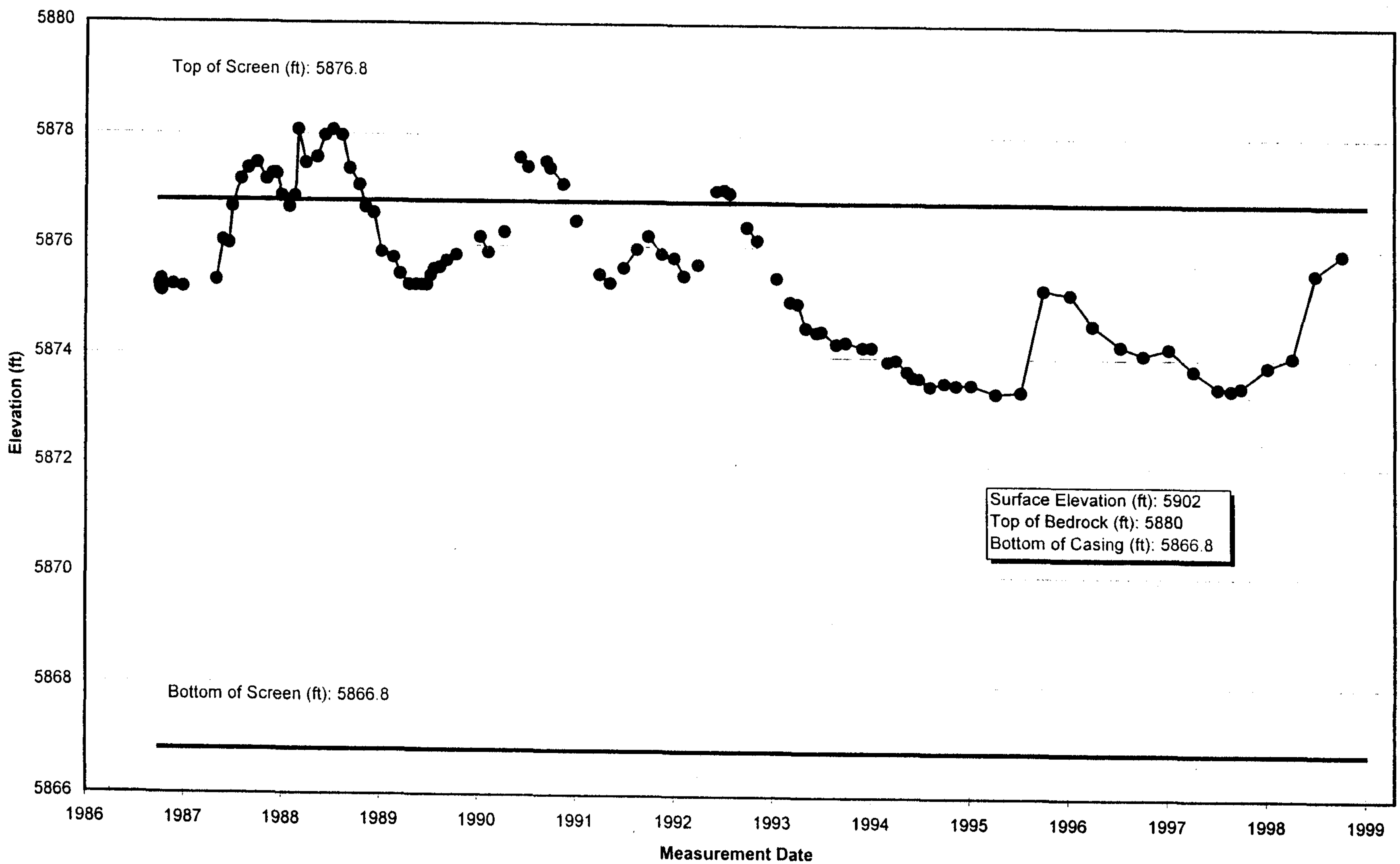
S14_97.xls 62593 9/22/99

Hydrograph 6286



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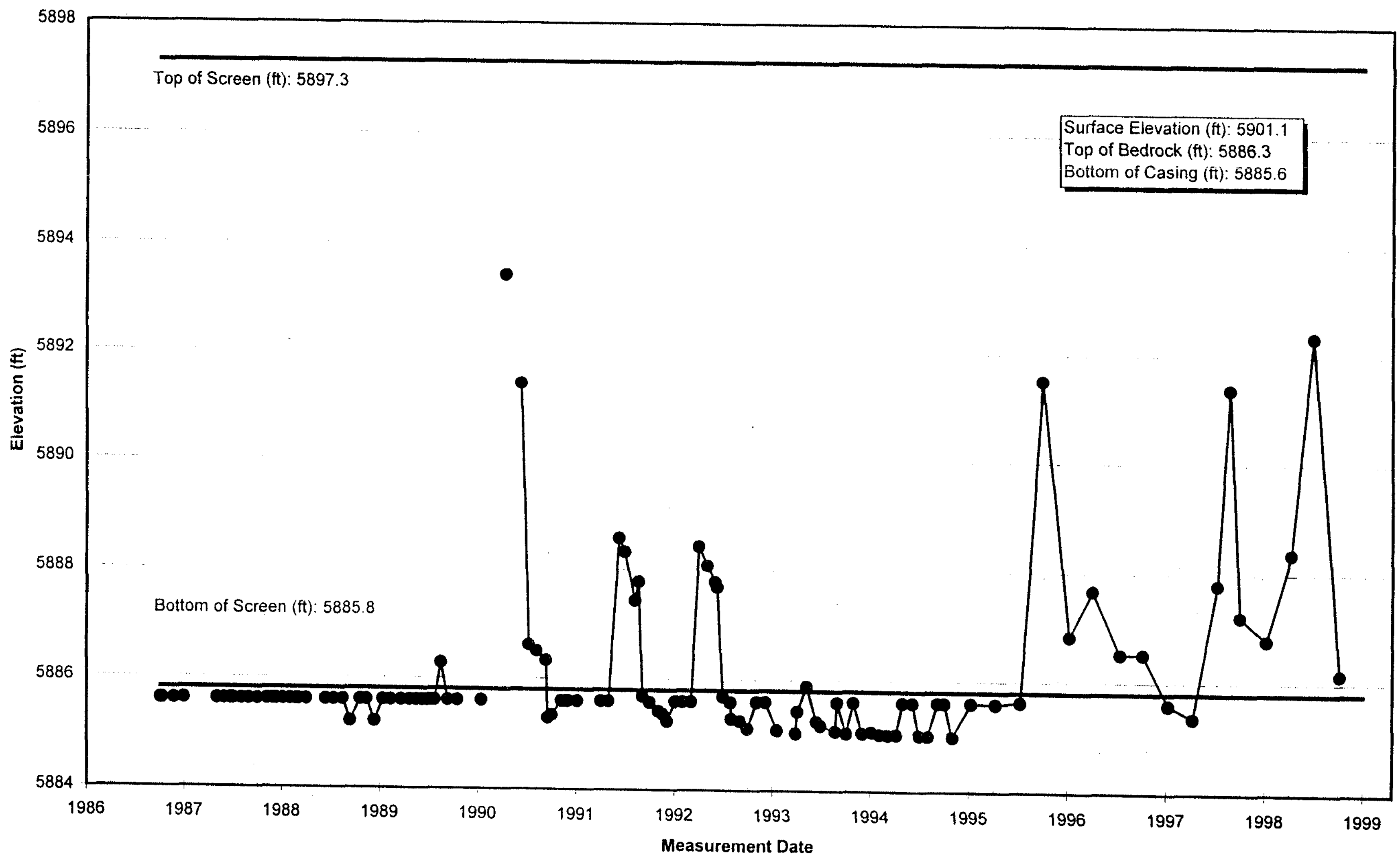
S14_97 6 9/22/99

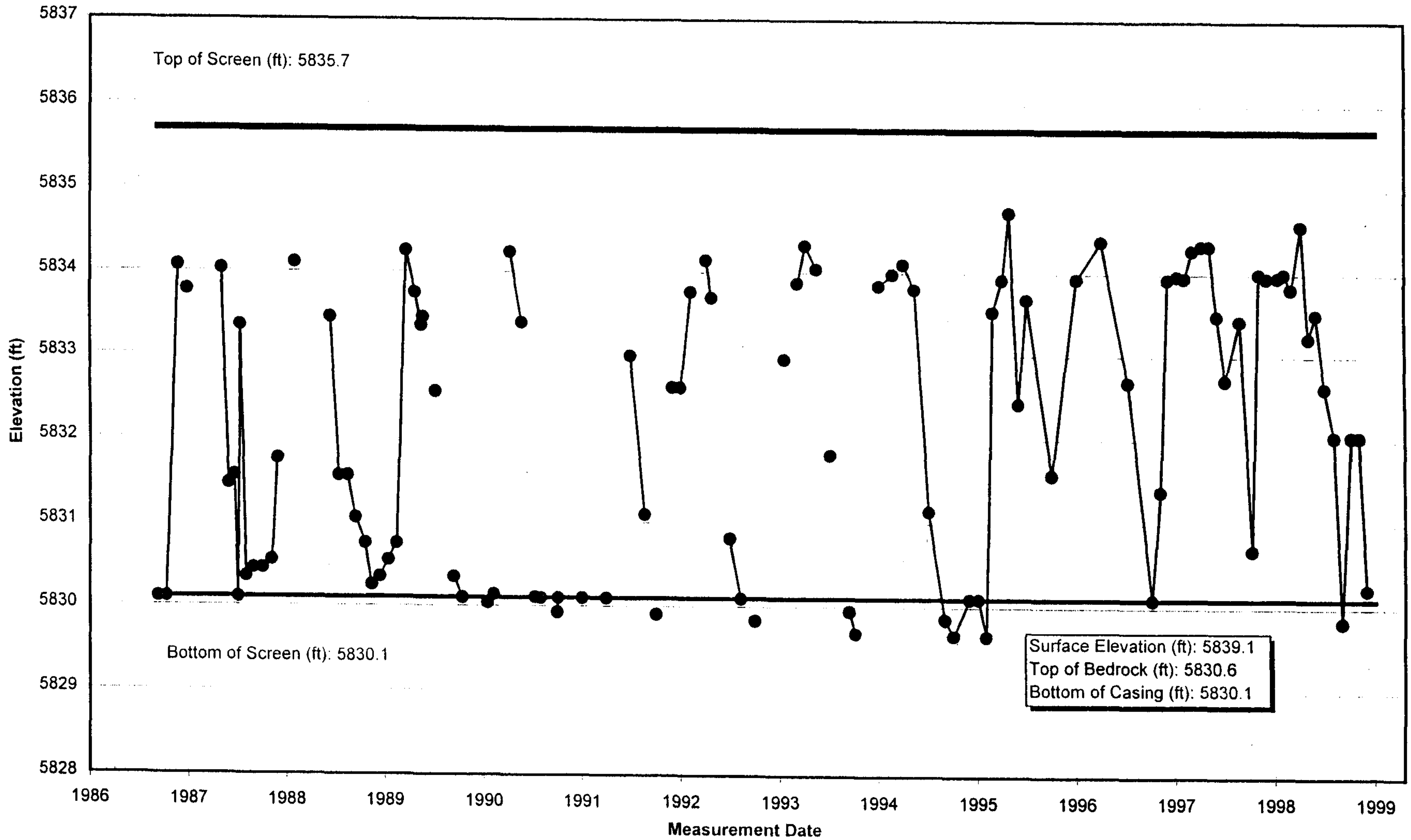
Hydrograph 6386



333 S14_97.xls 6386 9/22/99

334

Hydrograph 6486



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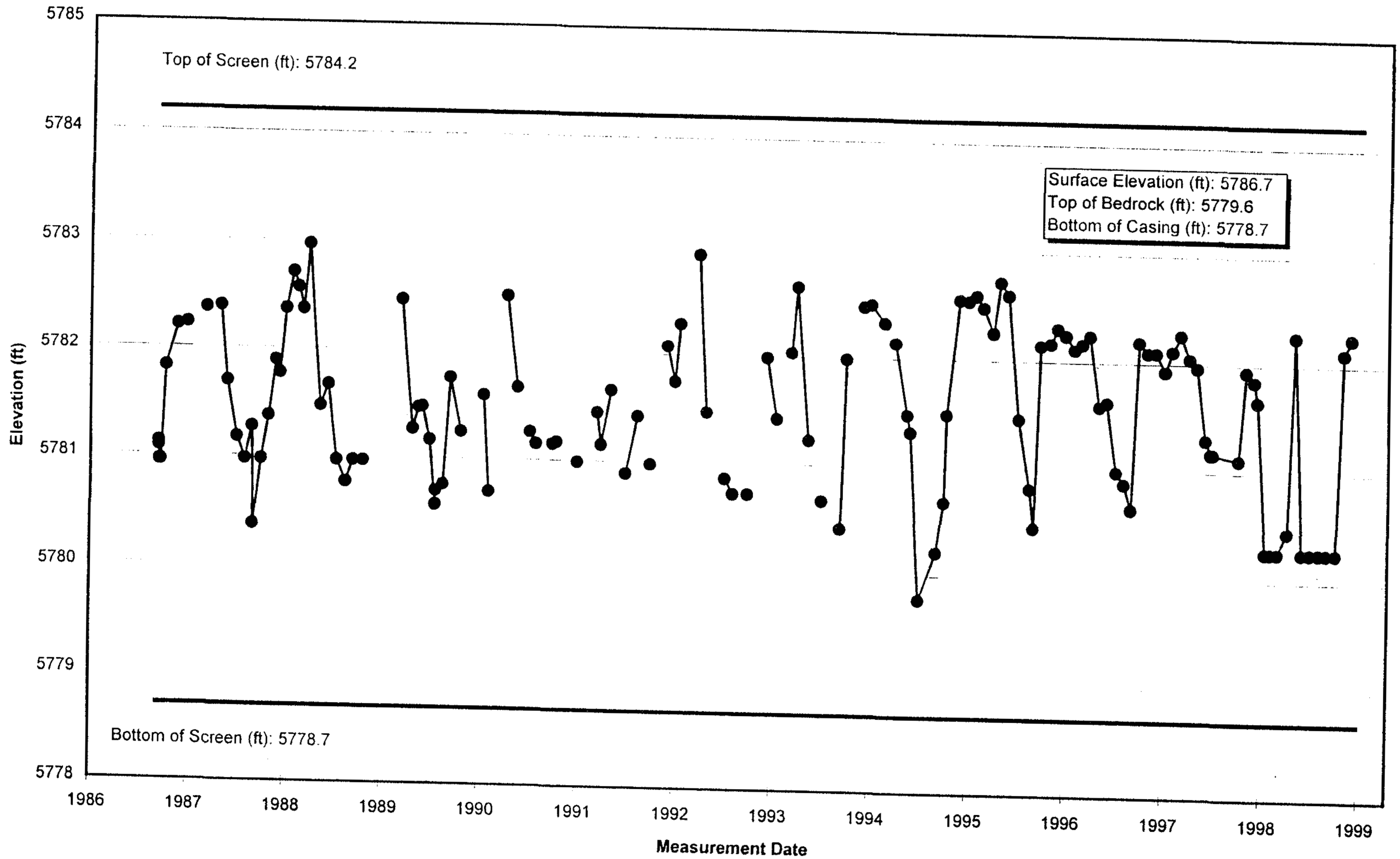
S14_9 86 9/22/99

Hydrograph 6586



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335
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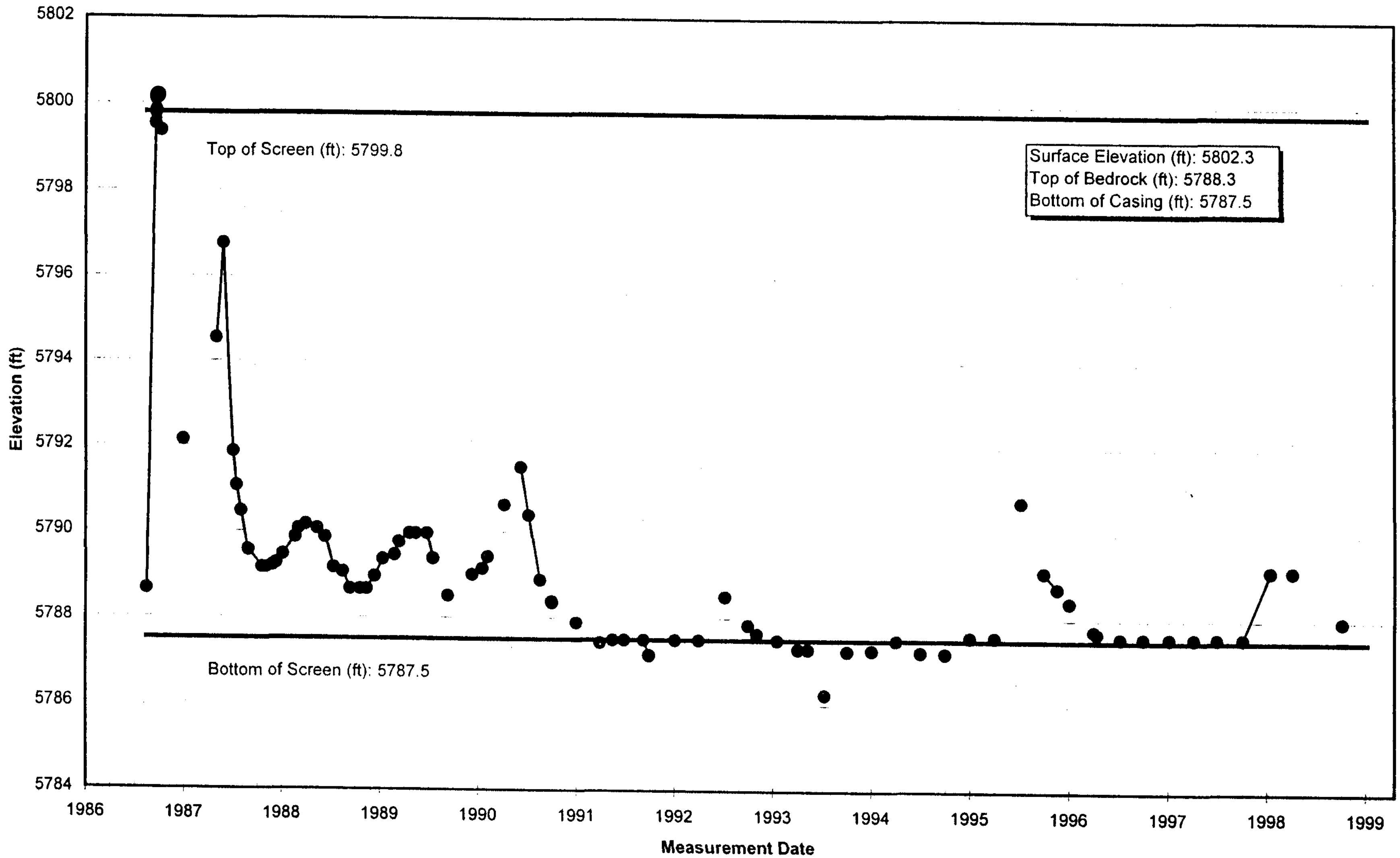
Hydrograph 6786



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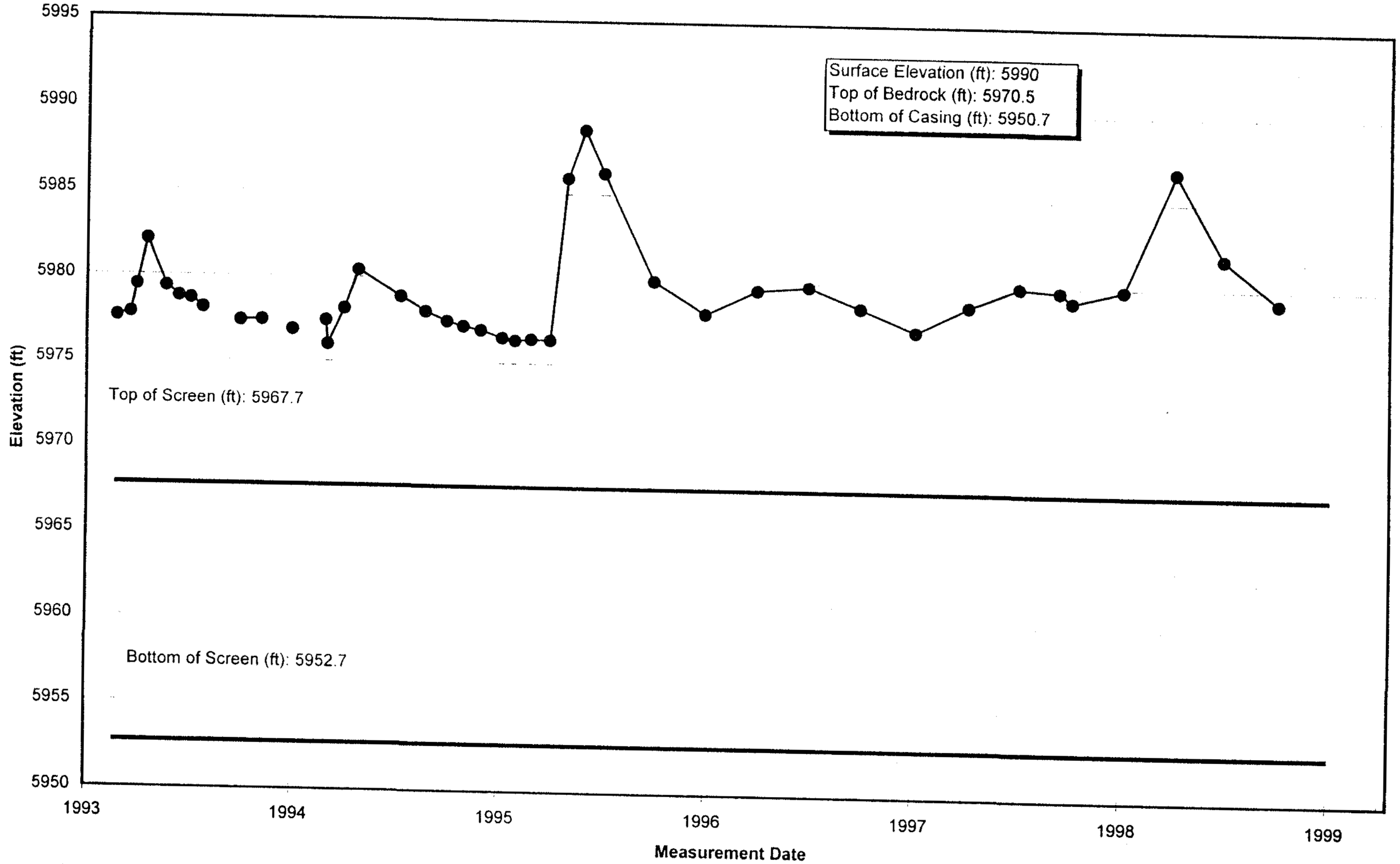

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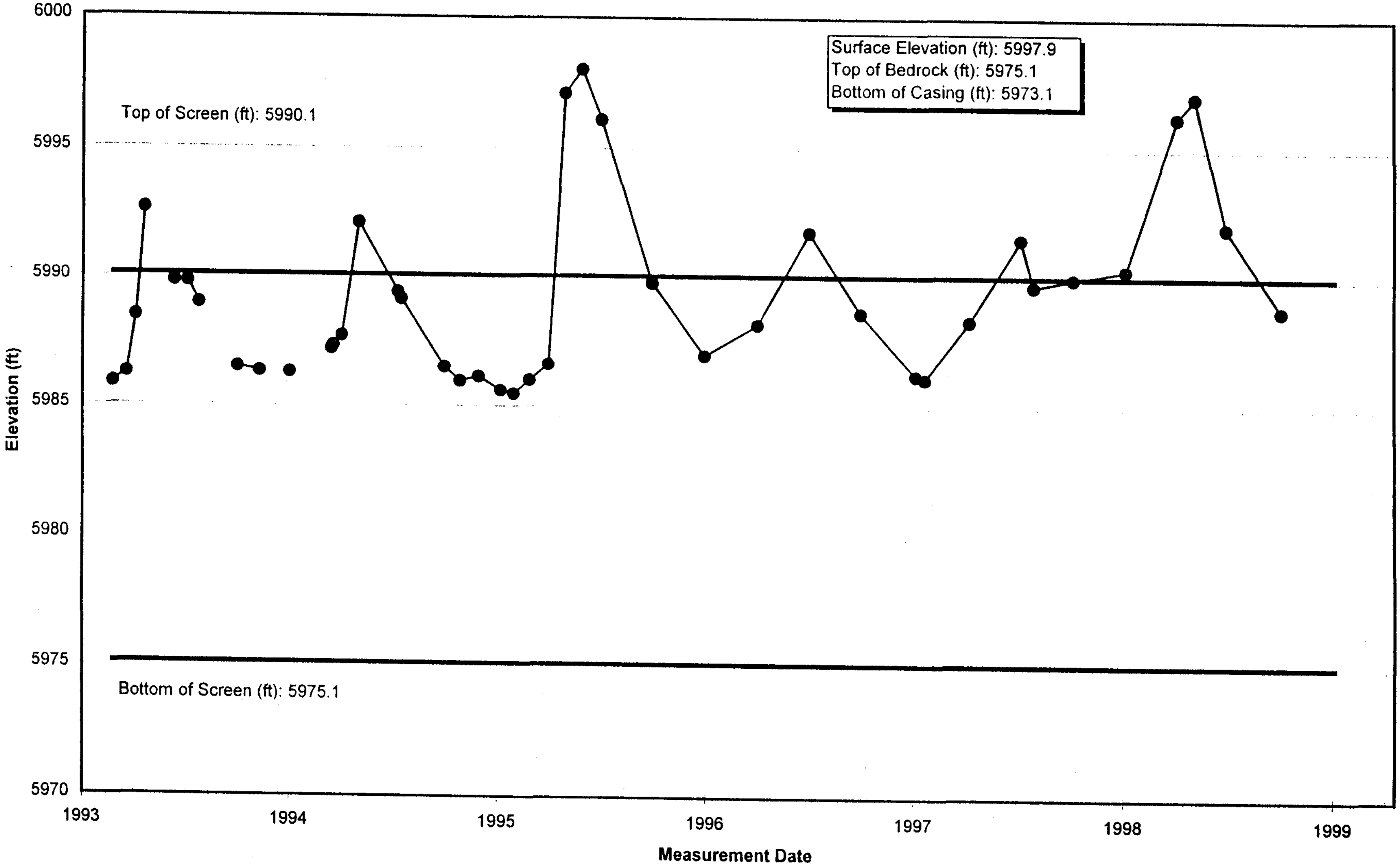

338
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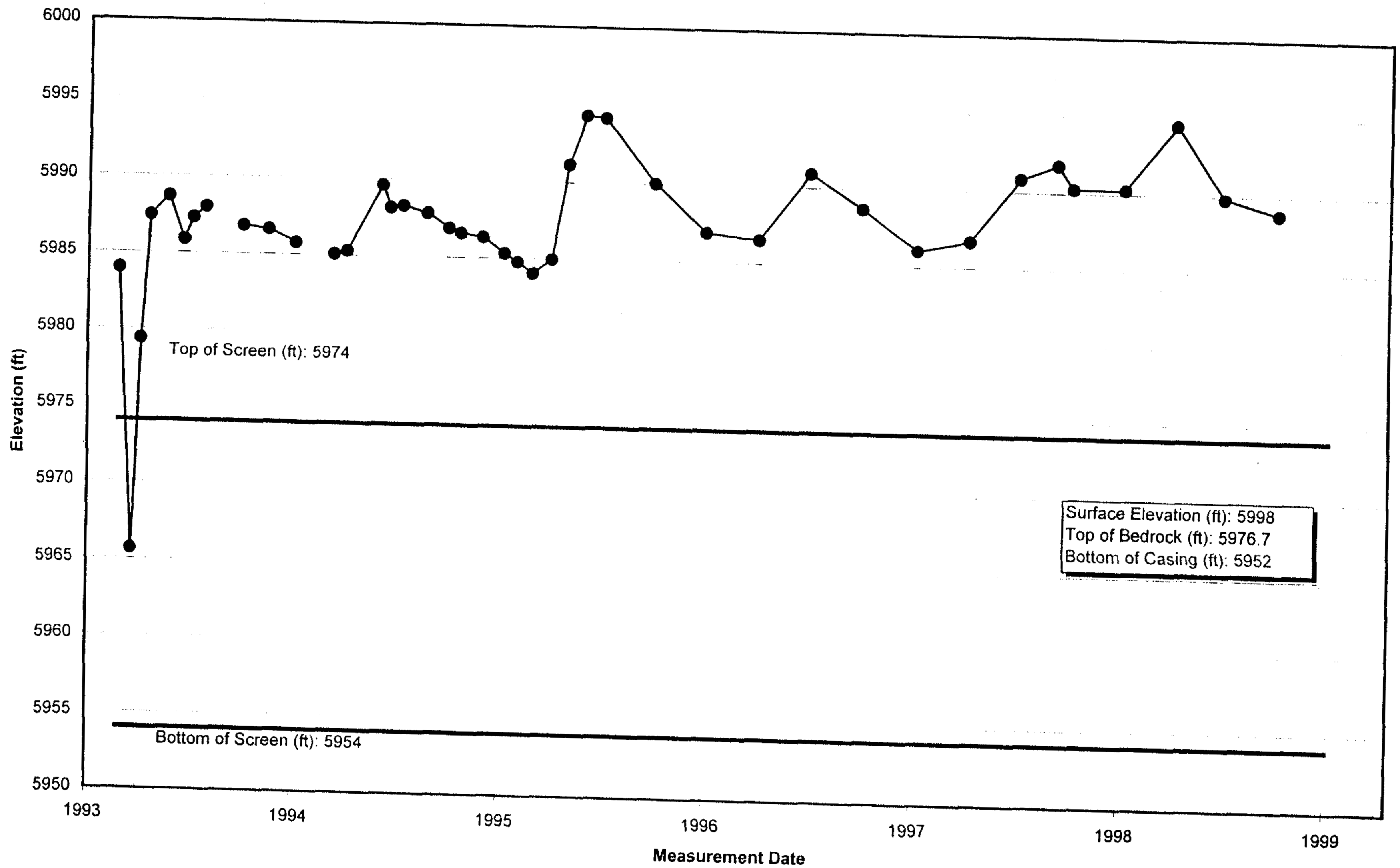
Hydrograph 70493



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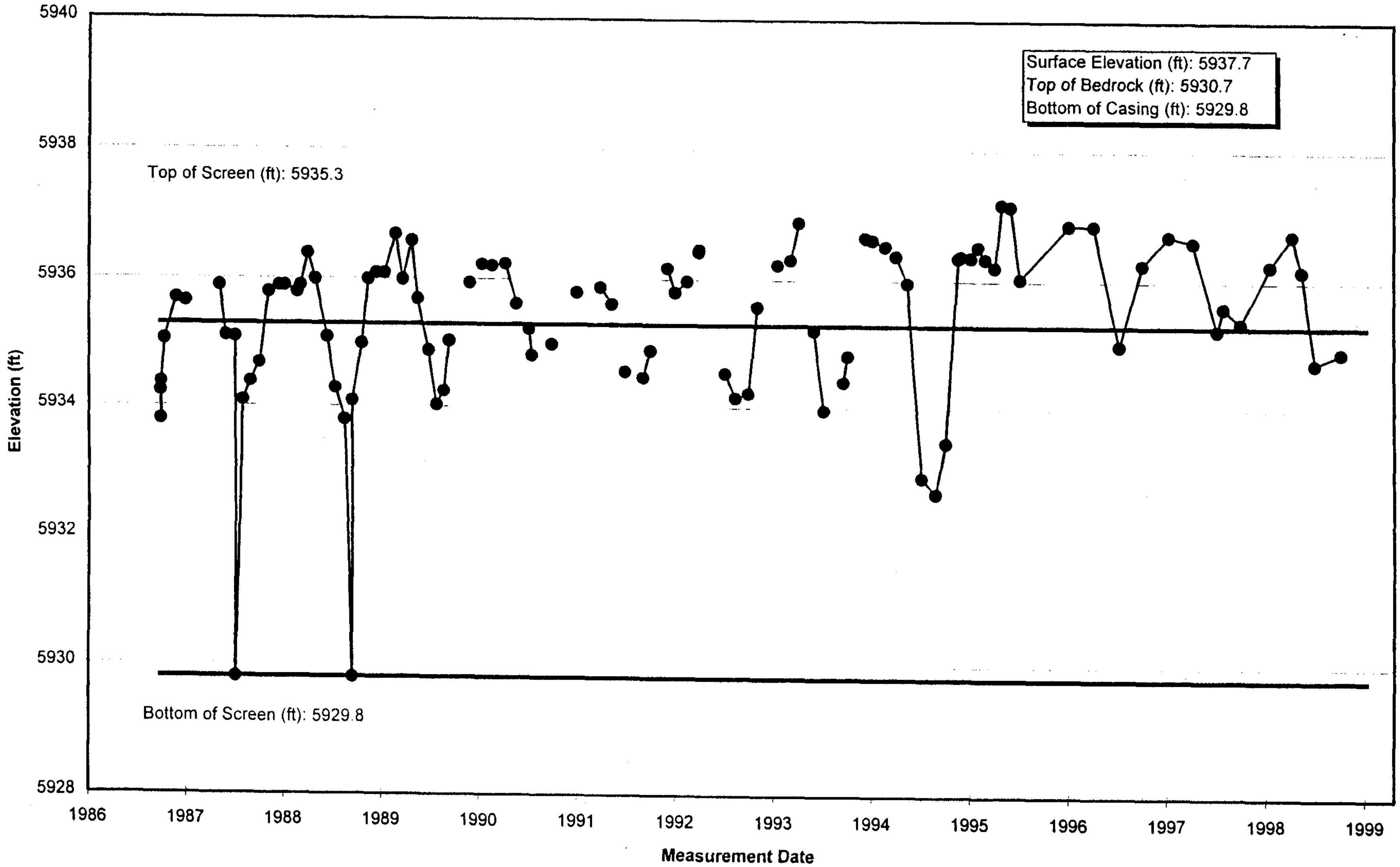
Hydrograph 7086



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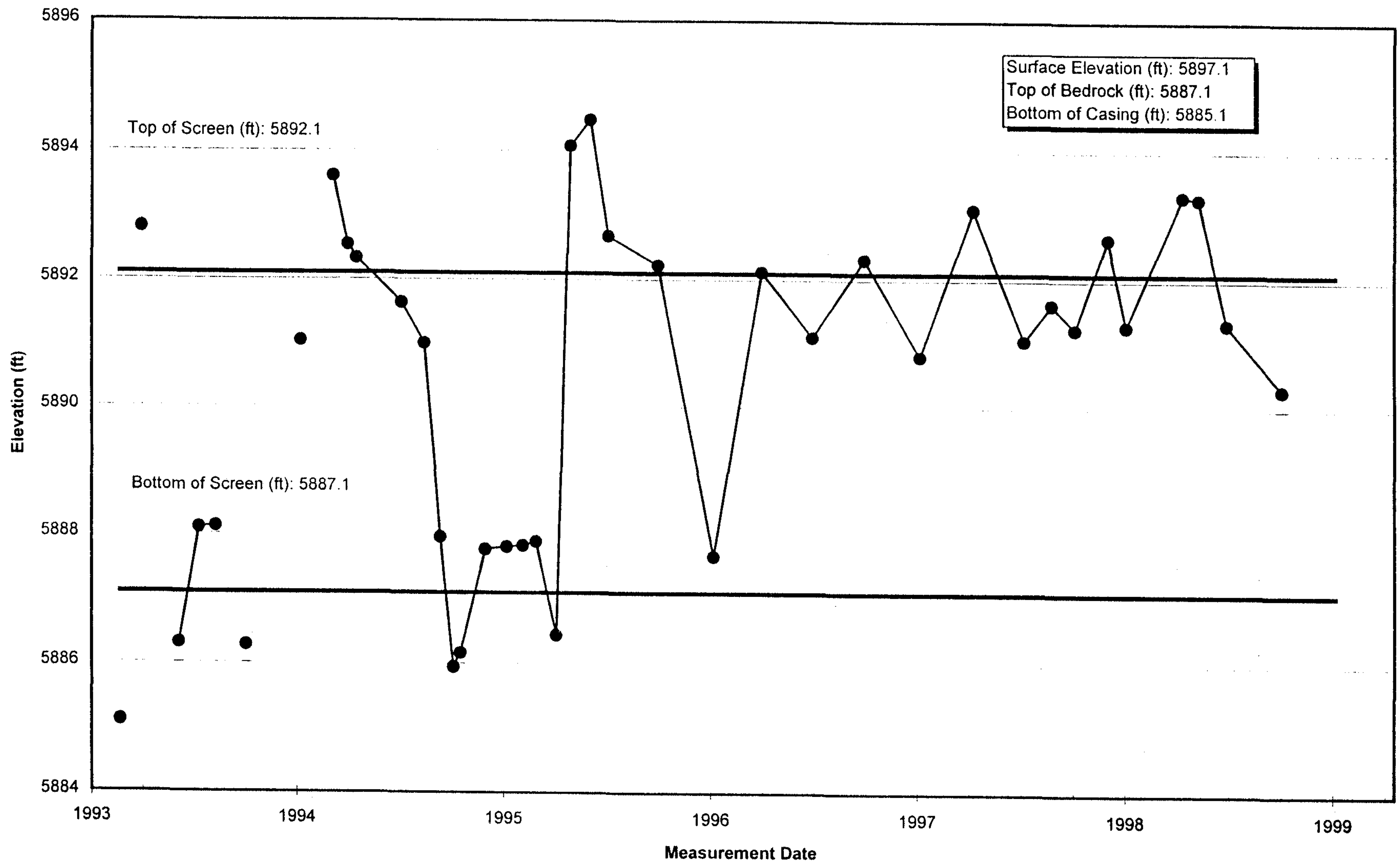
S15_9[illegible]86 9/22/99

Hydrograph 75992



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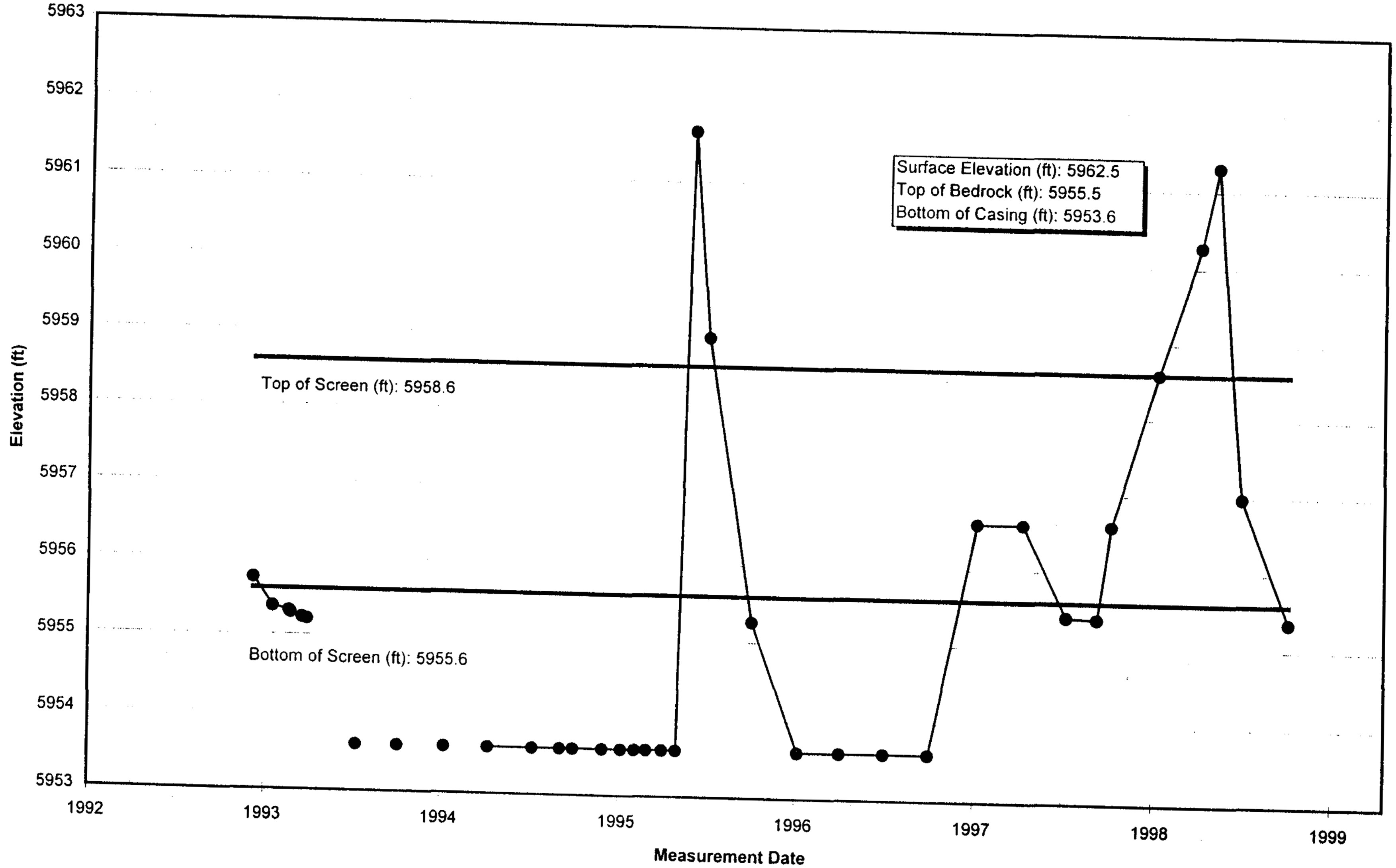
282

S16_97.xls 75992 9/22/99

Hydrograph 77392



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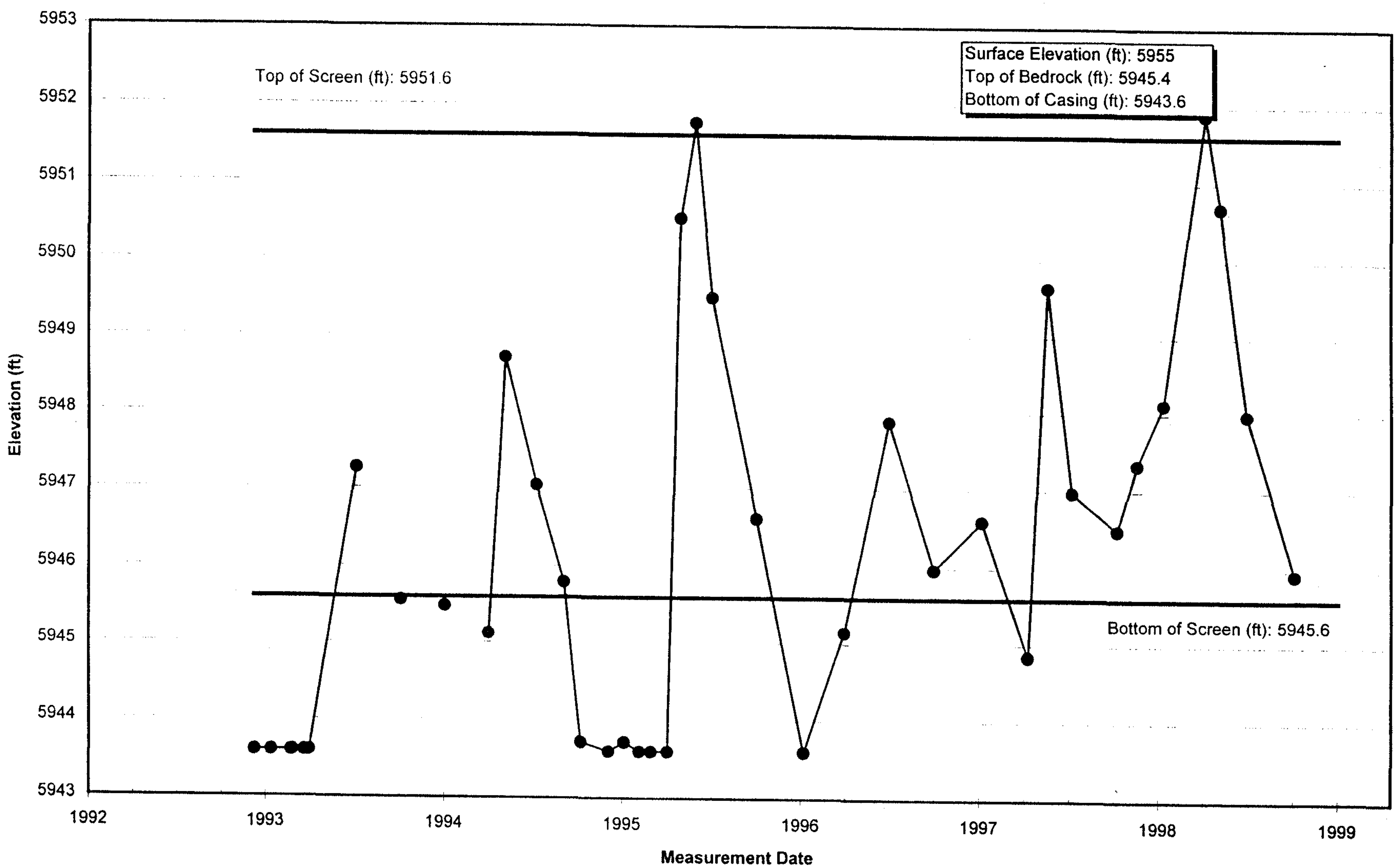

343 S16_97.xls 76992 9/22/99

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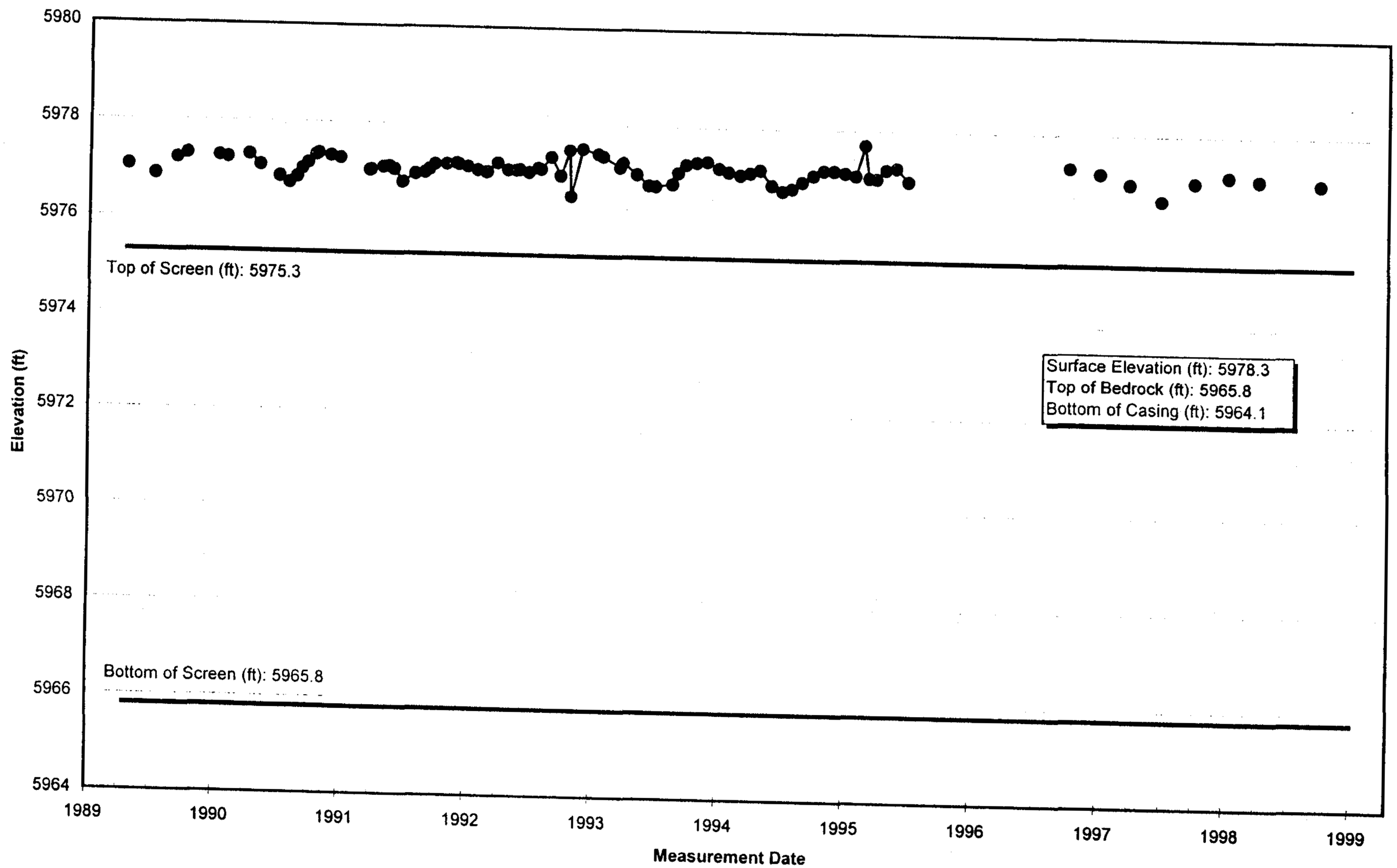
Hydrograph B102289



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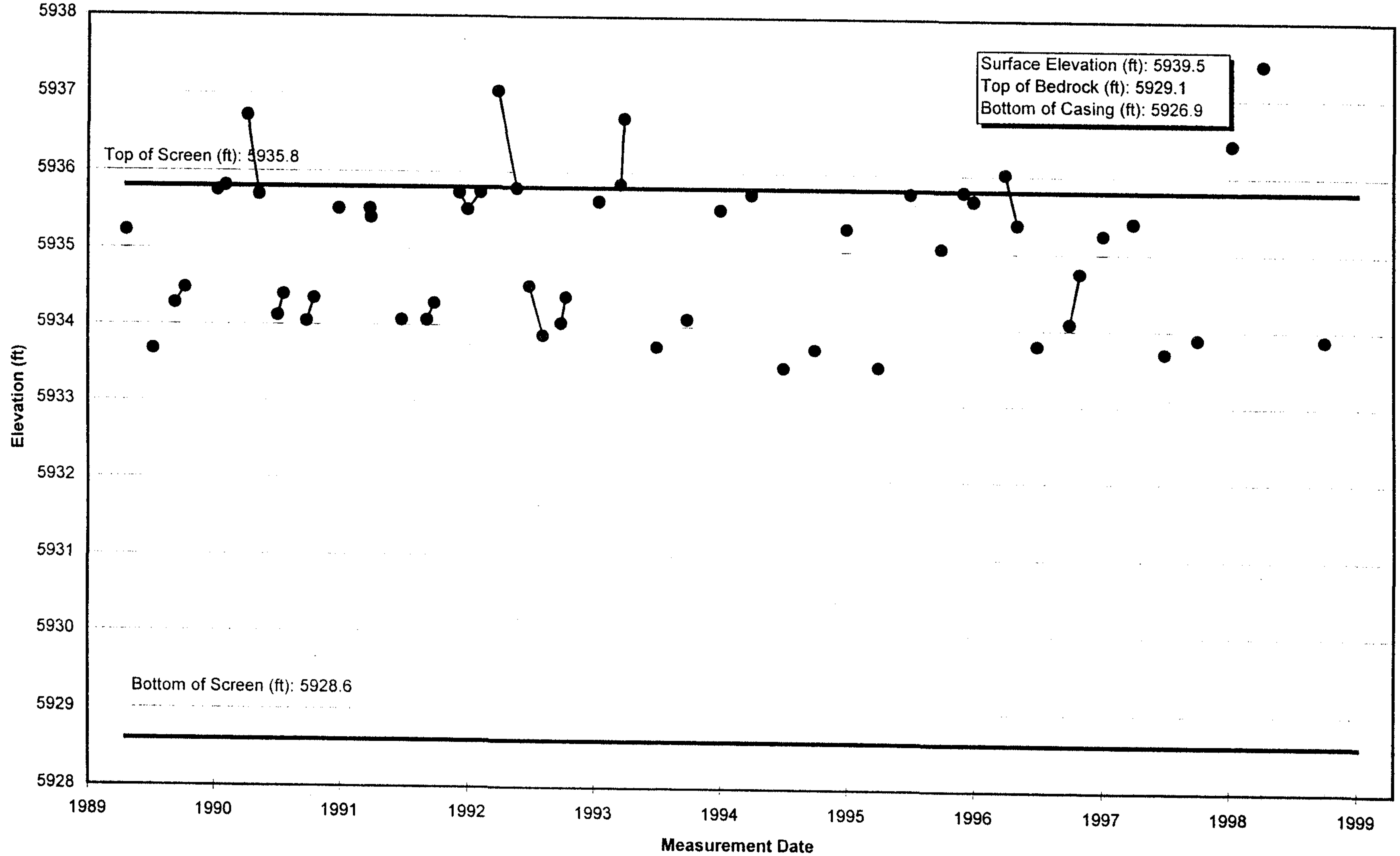

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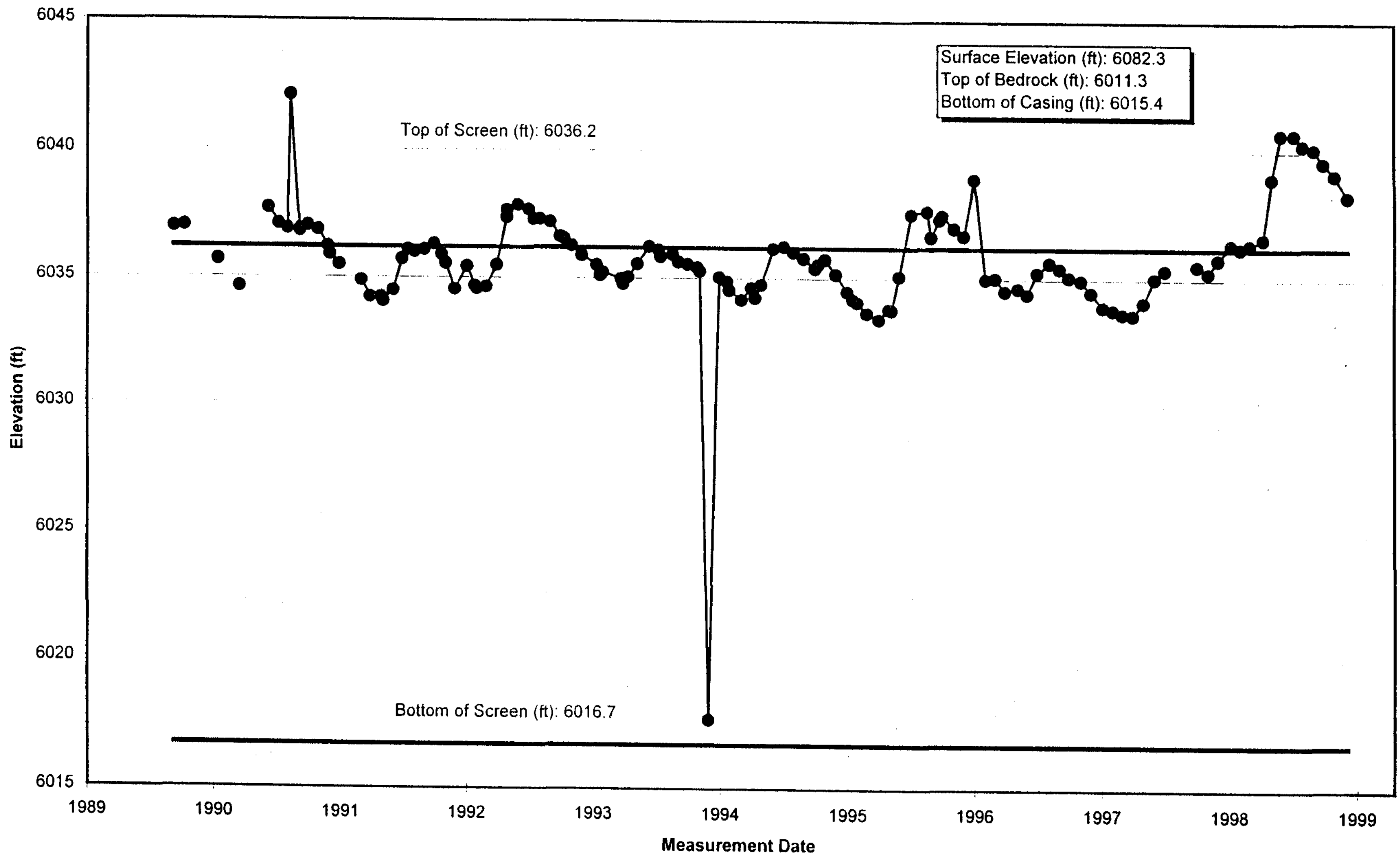
Hydrograph B110989



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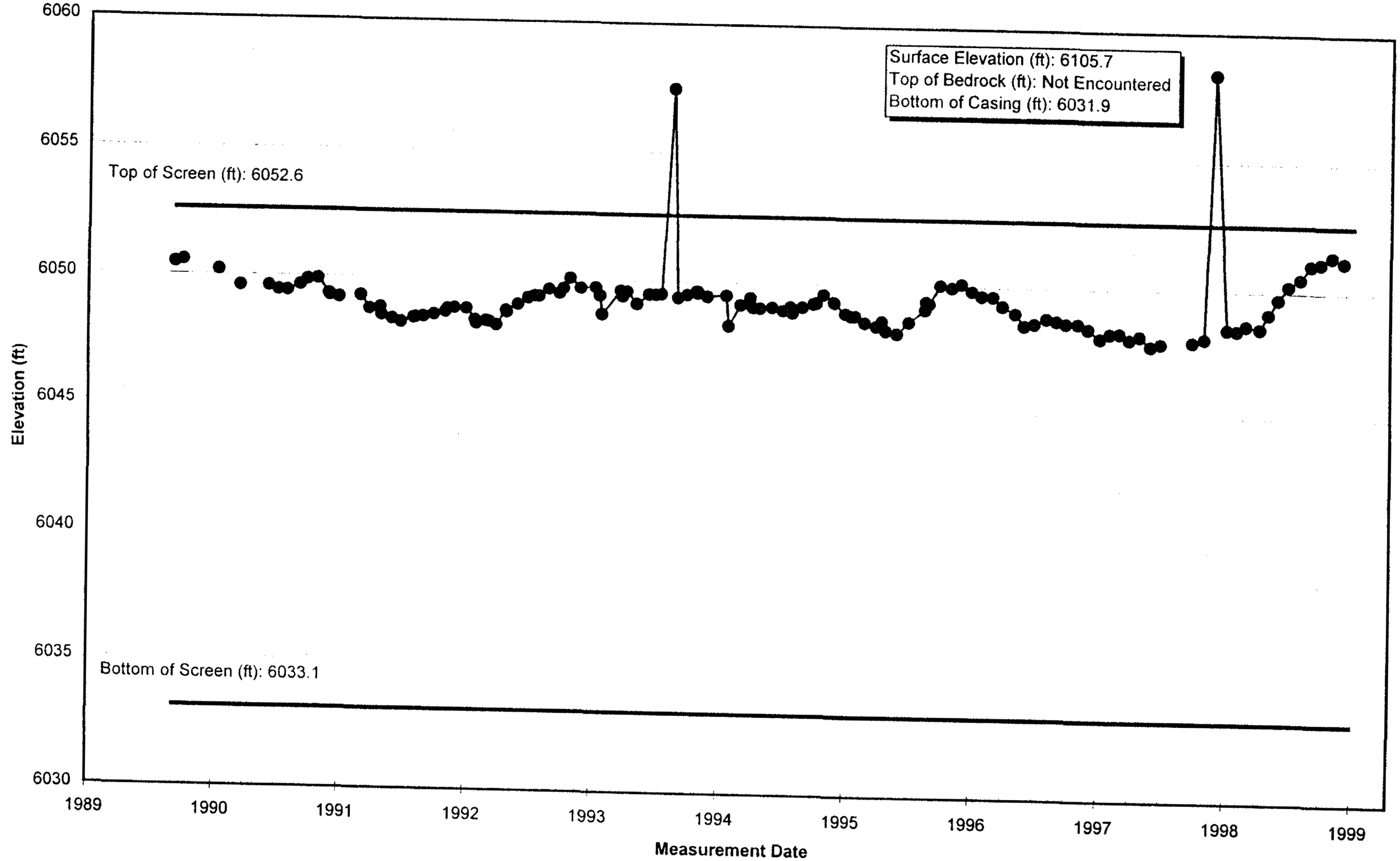

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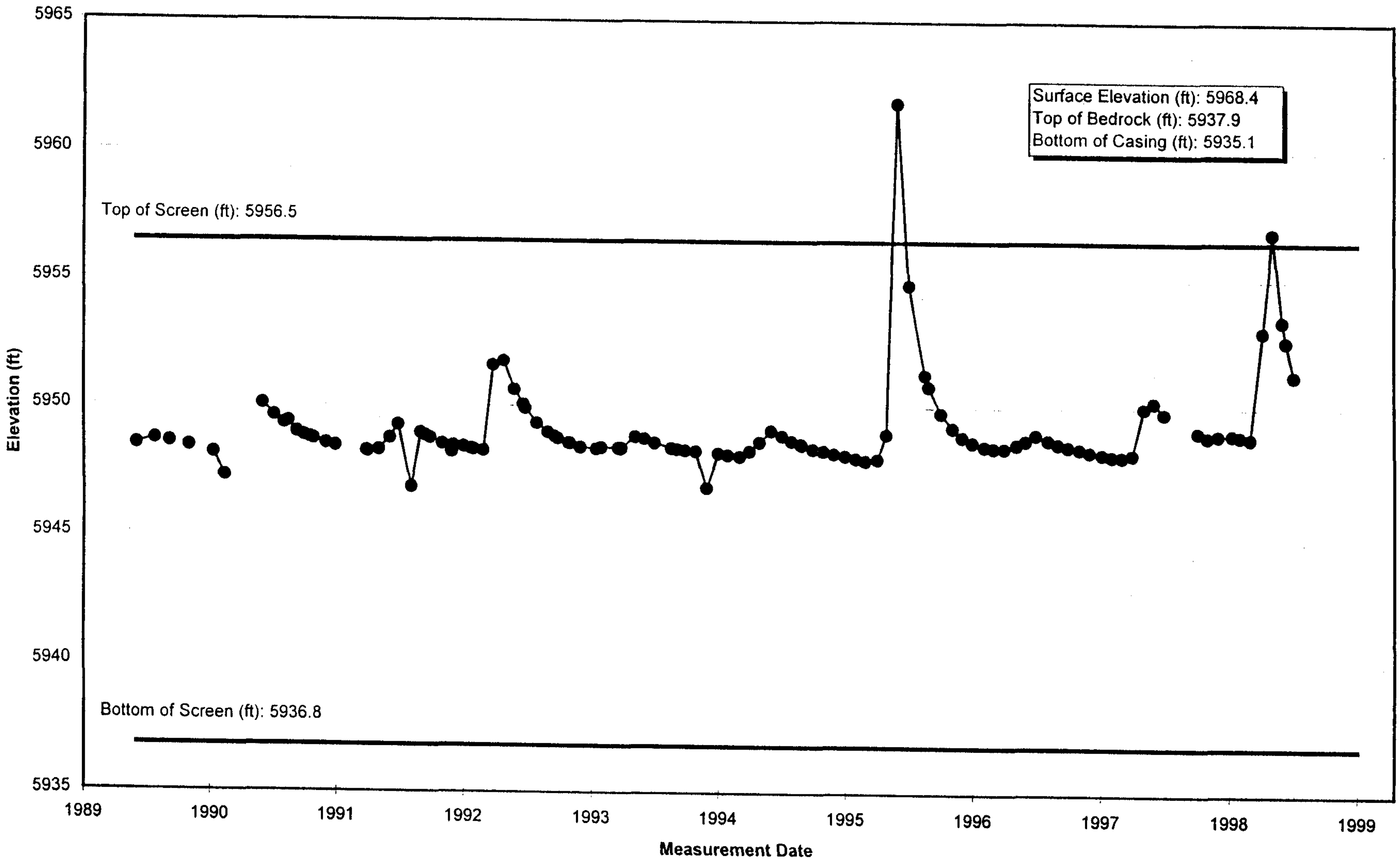
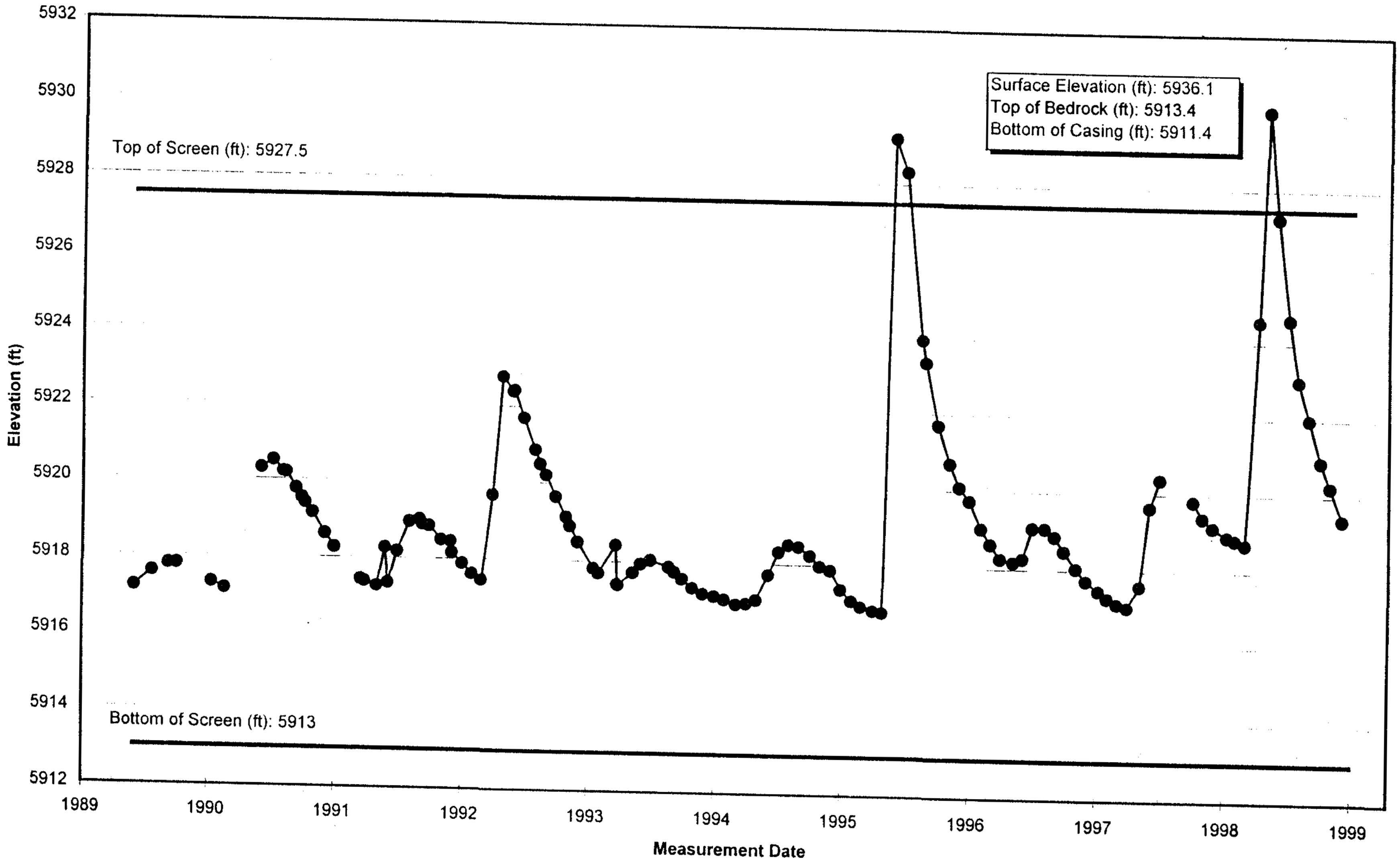
Hydrograph B200589



S16_ 00589 9/22/99

348
349

Hydrograph B200889



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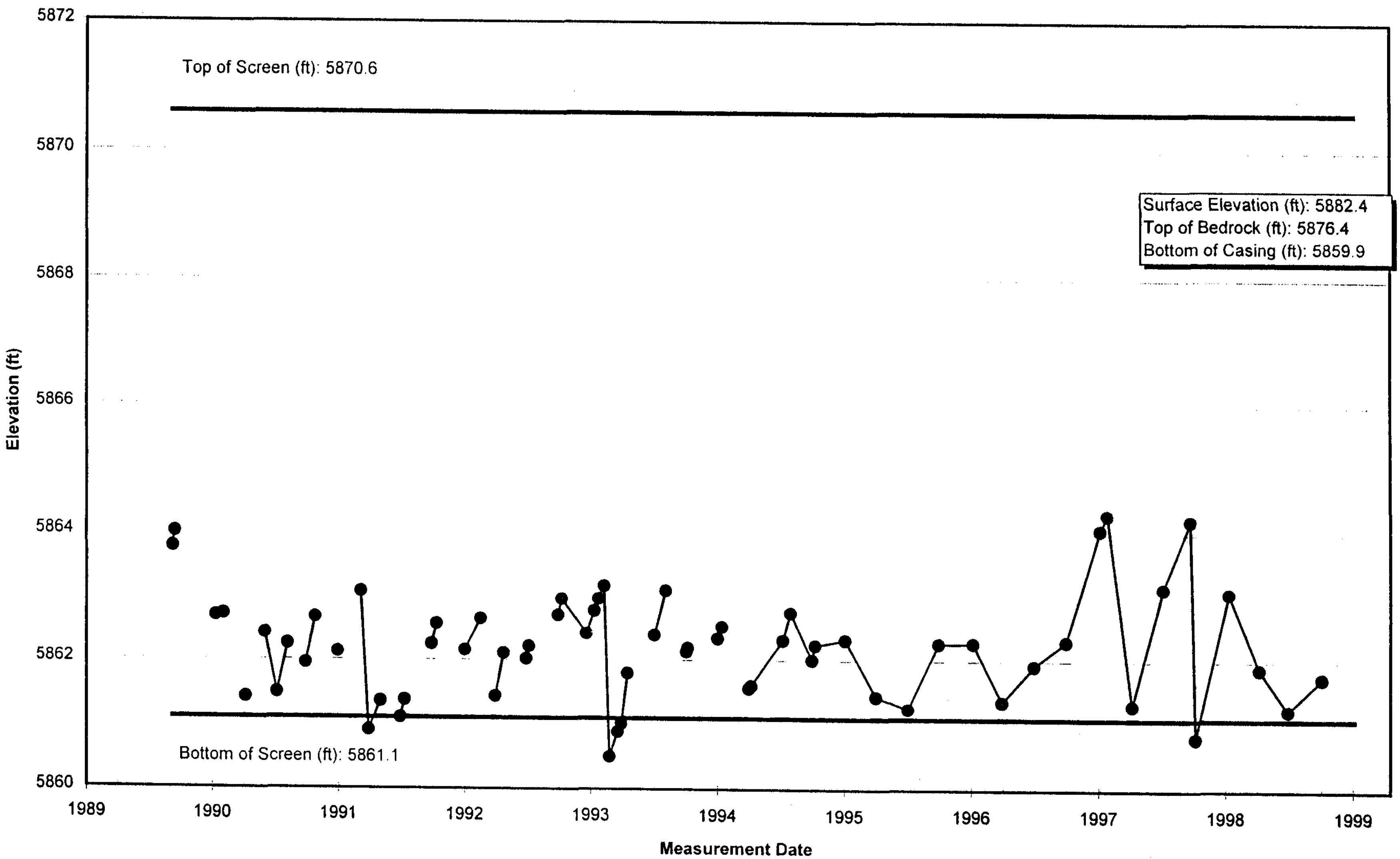
Hydrograph B206989



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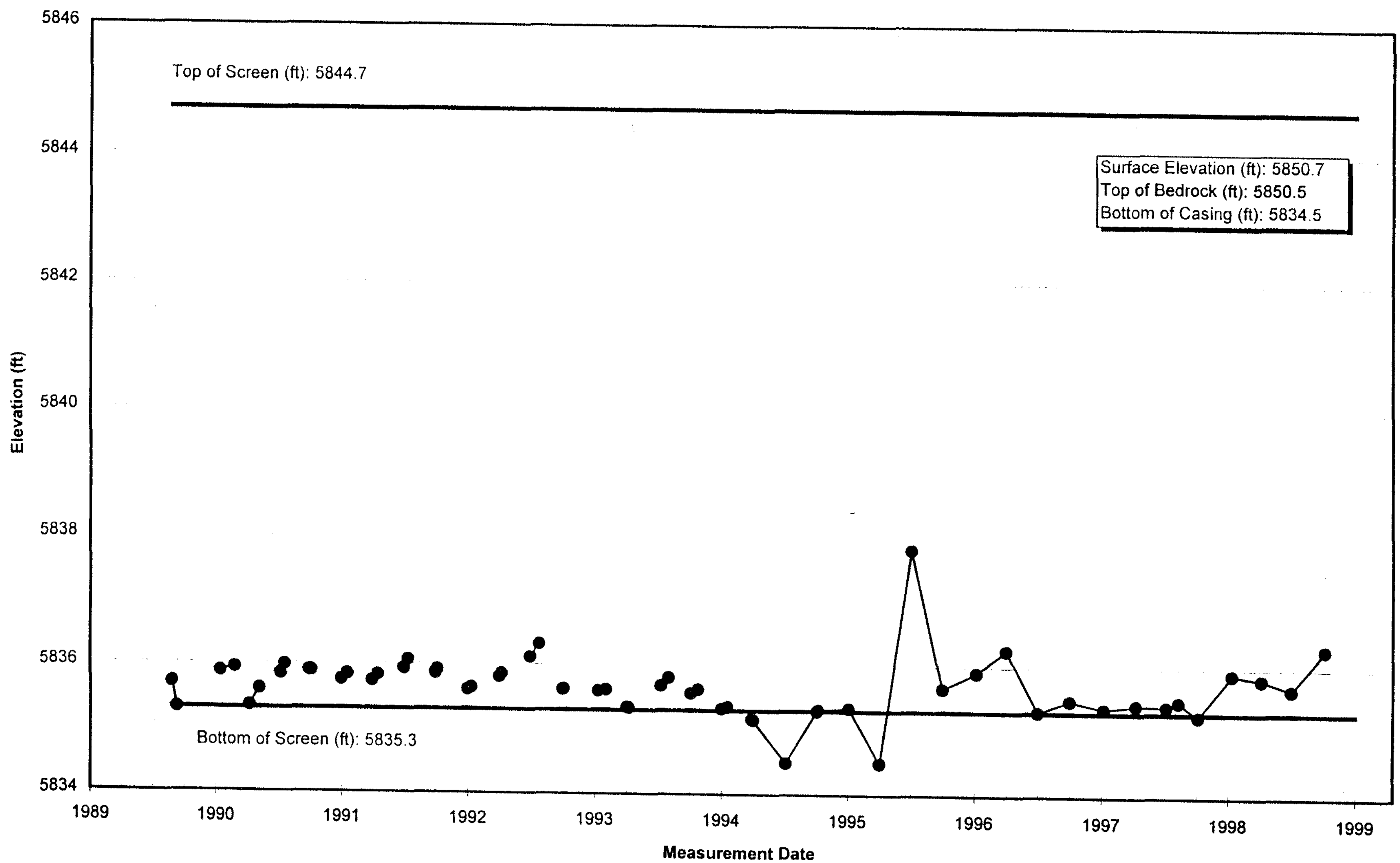
Hydrograph B208289



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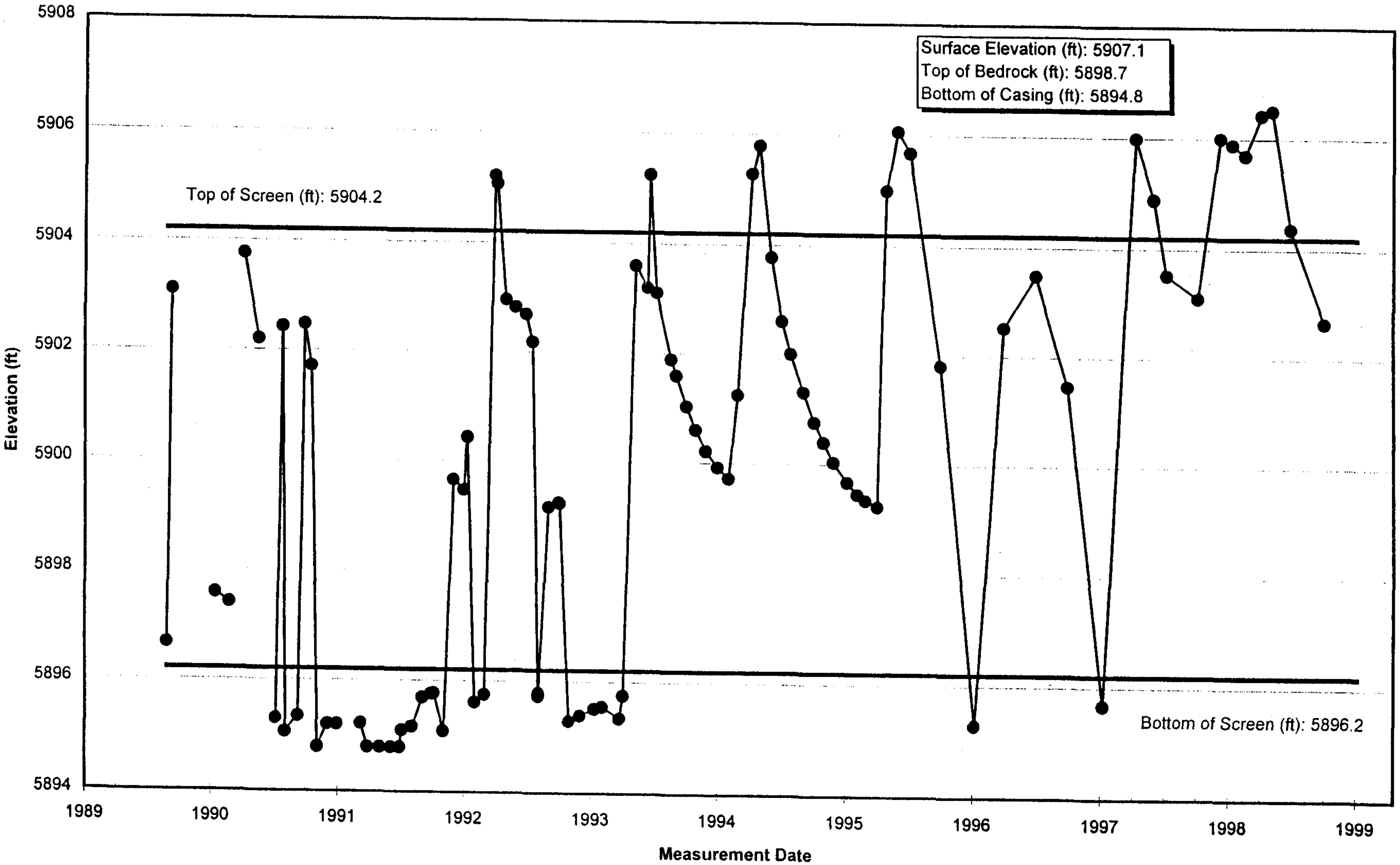
352

Hydrograph B208789



S18_97 8789 9/22/99

352
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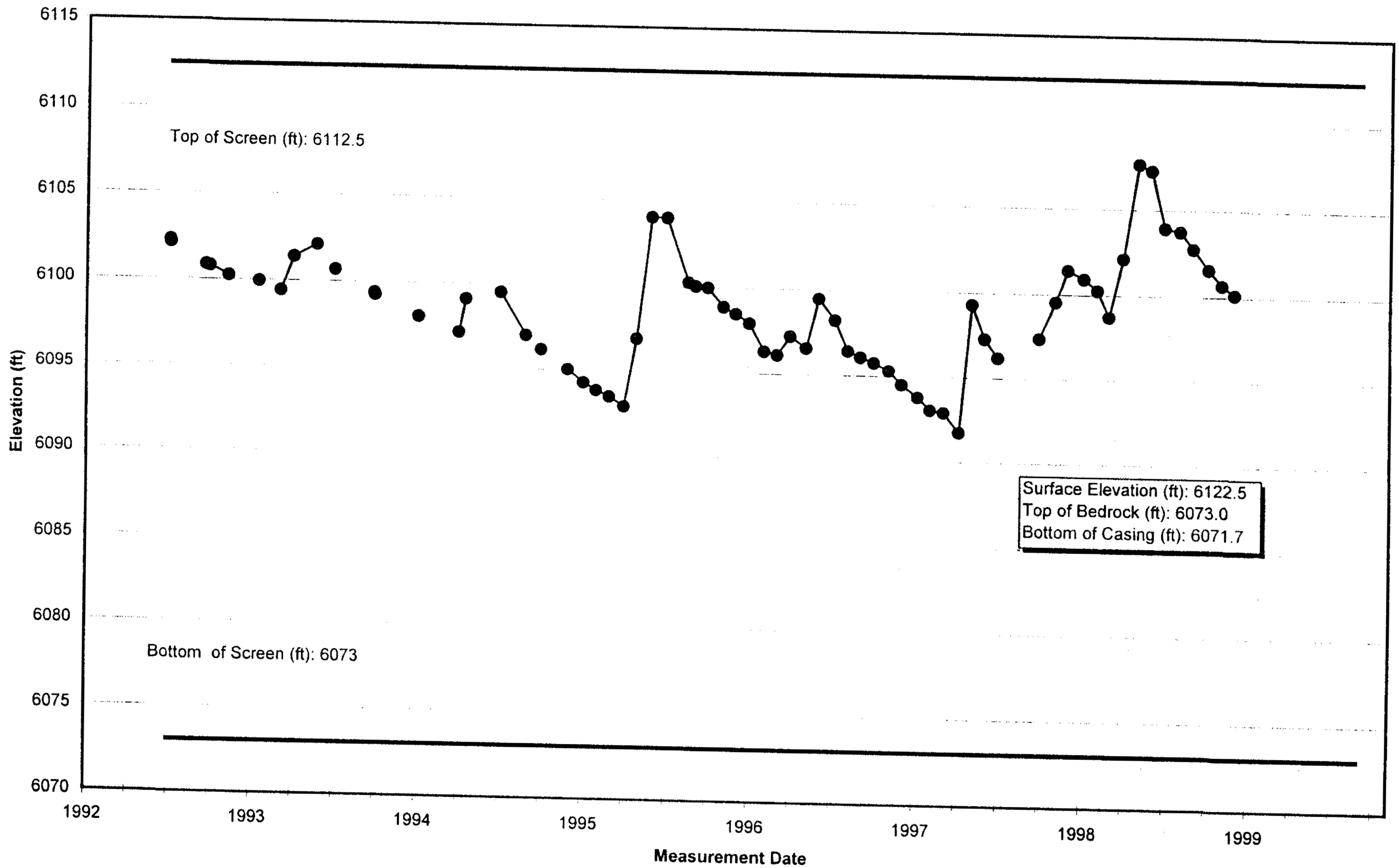
Hydrograph B400389



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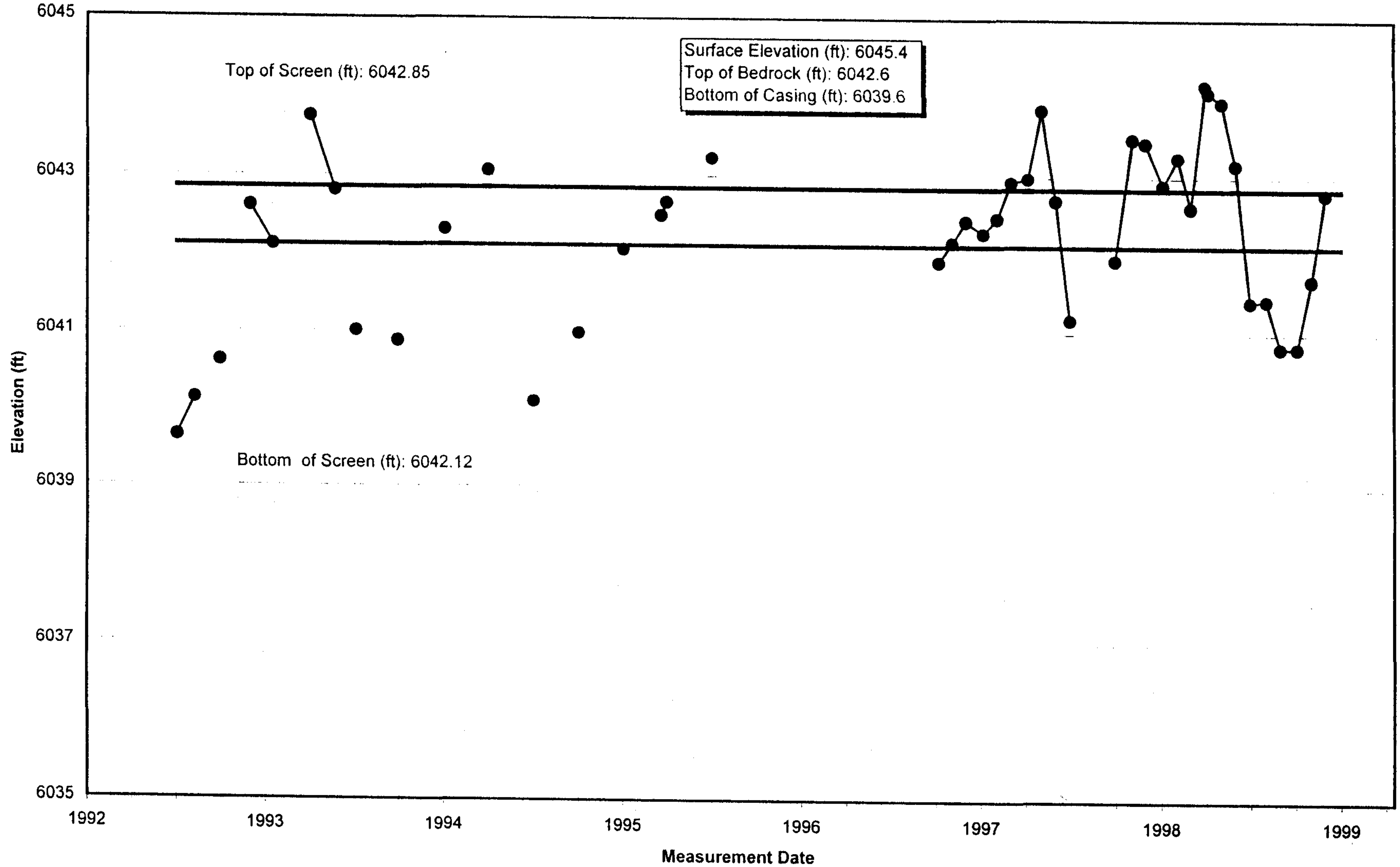

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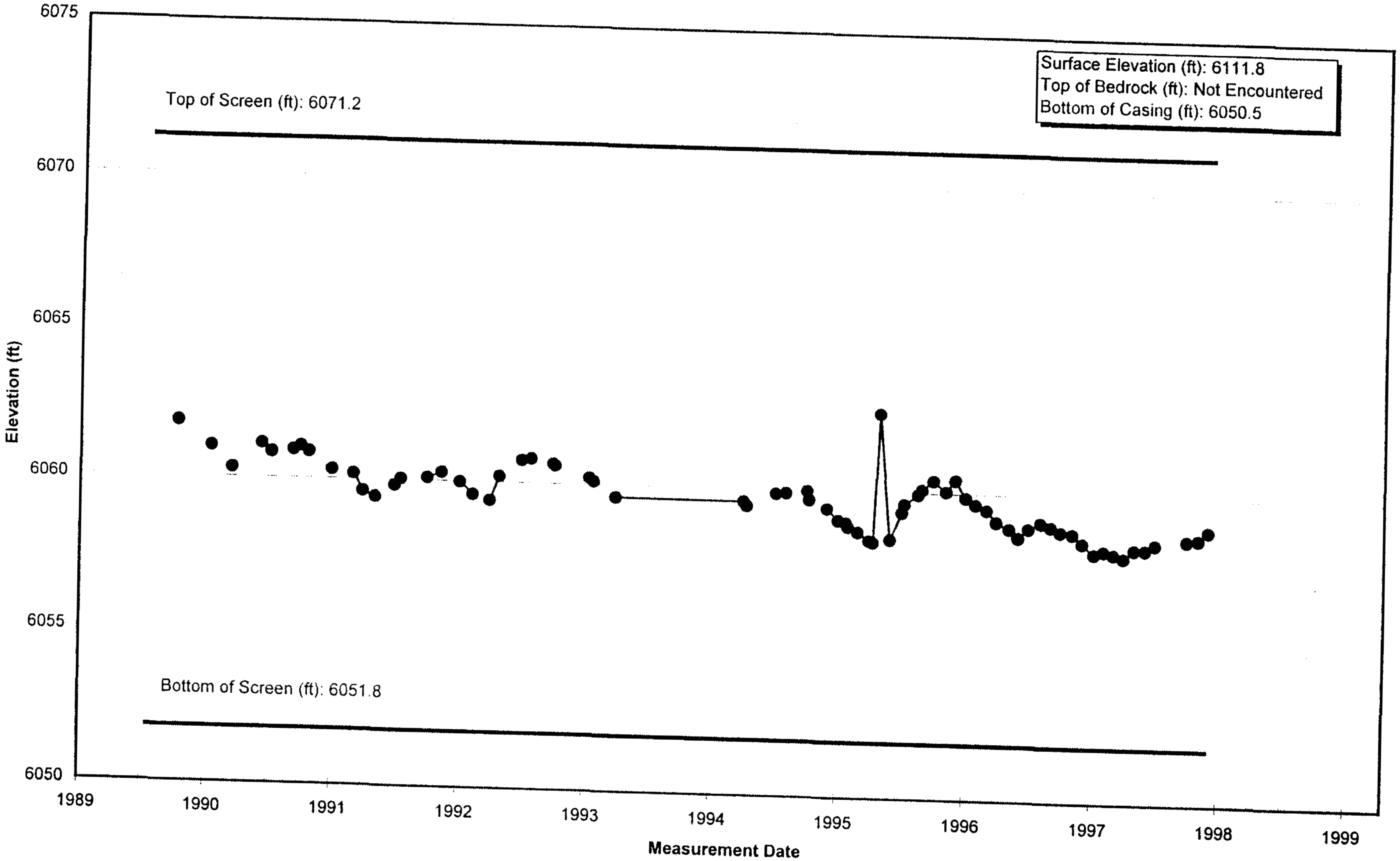
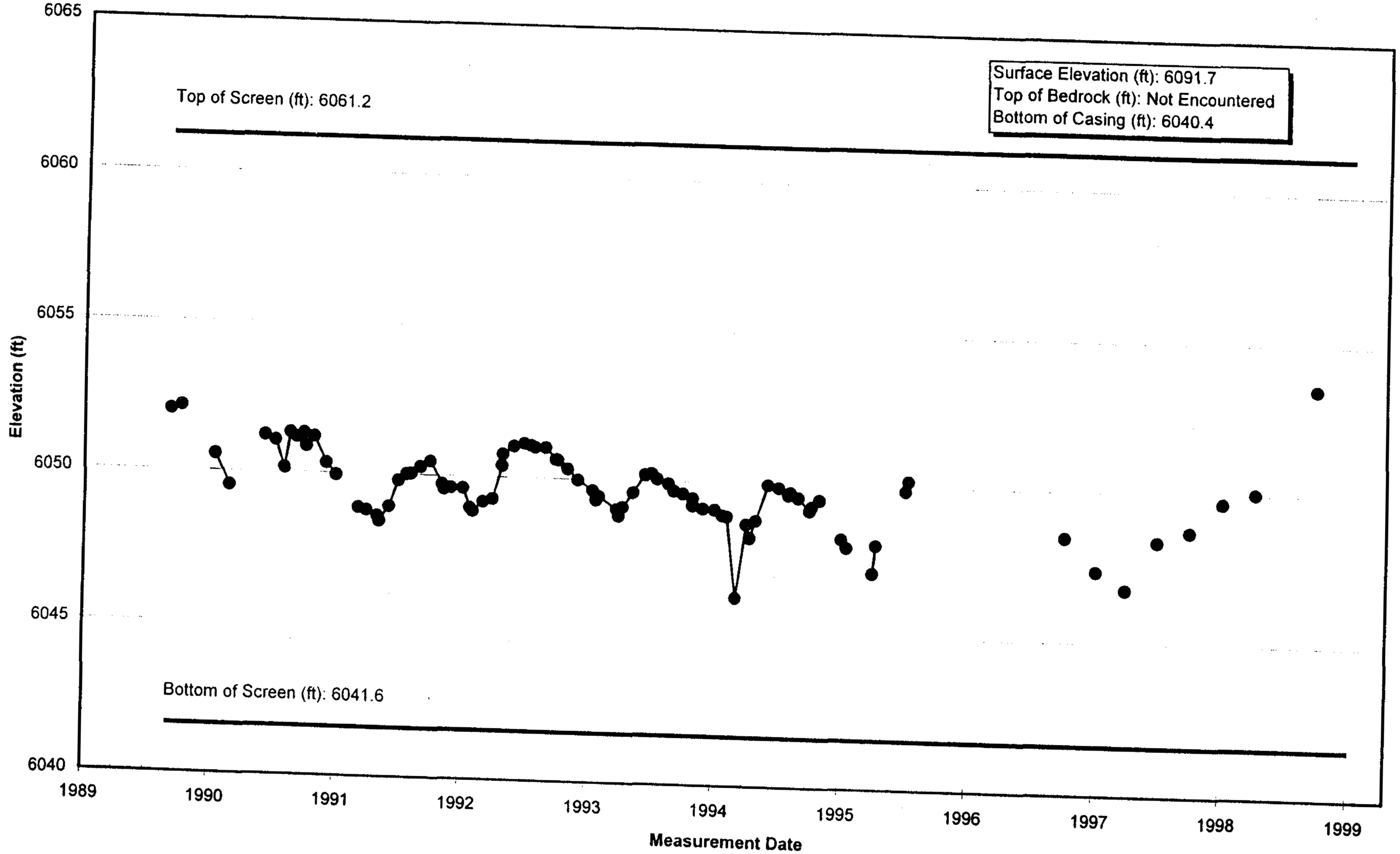
Hydrograph B410589



S20_97.xls B410589 9/22/99

355
358

Hydrograph B410689



356
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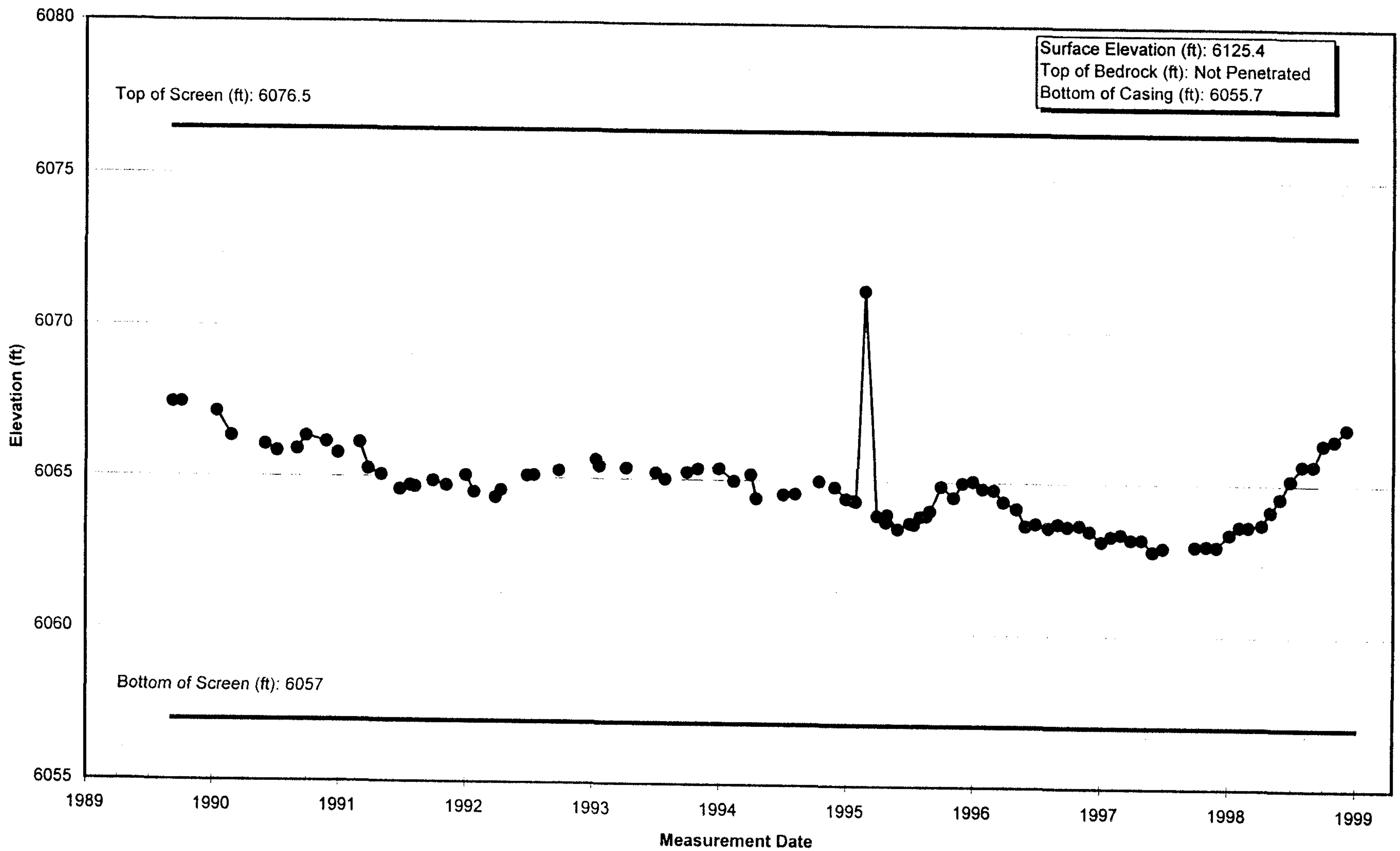
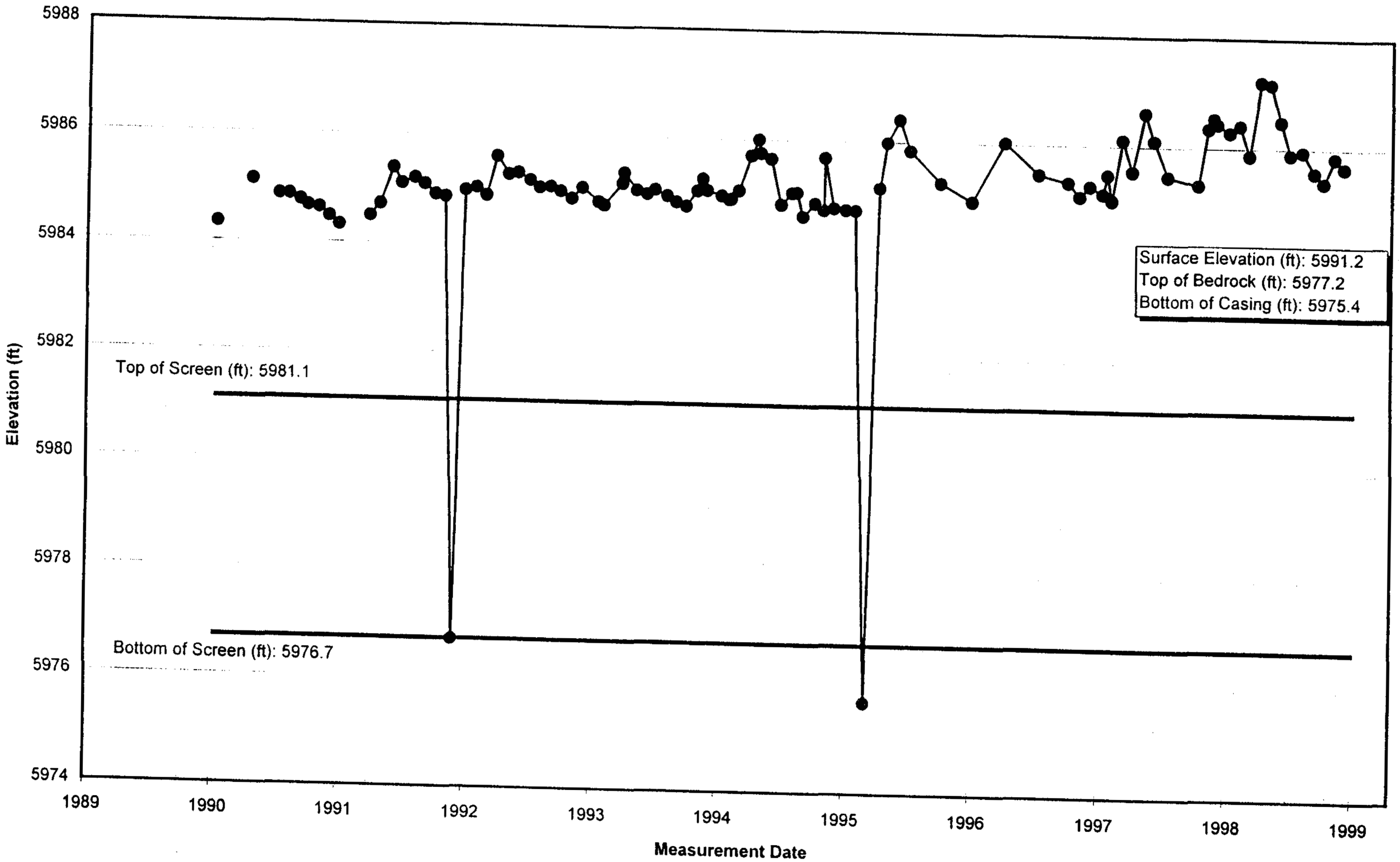


S20_97.xls B411289 9/22/99

~~357~~
~~360~~

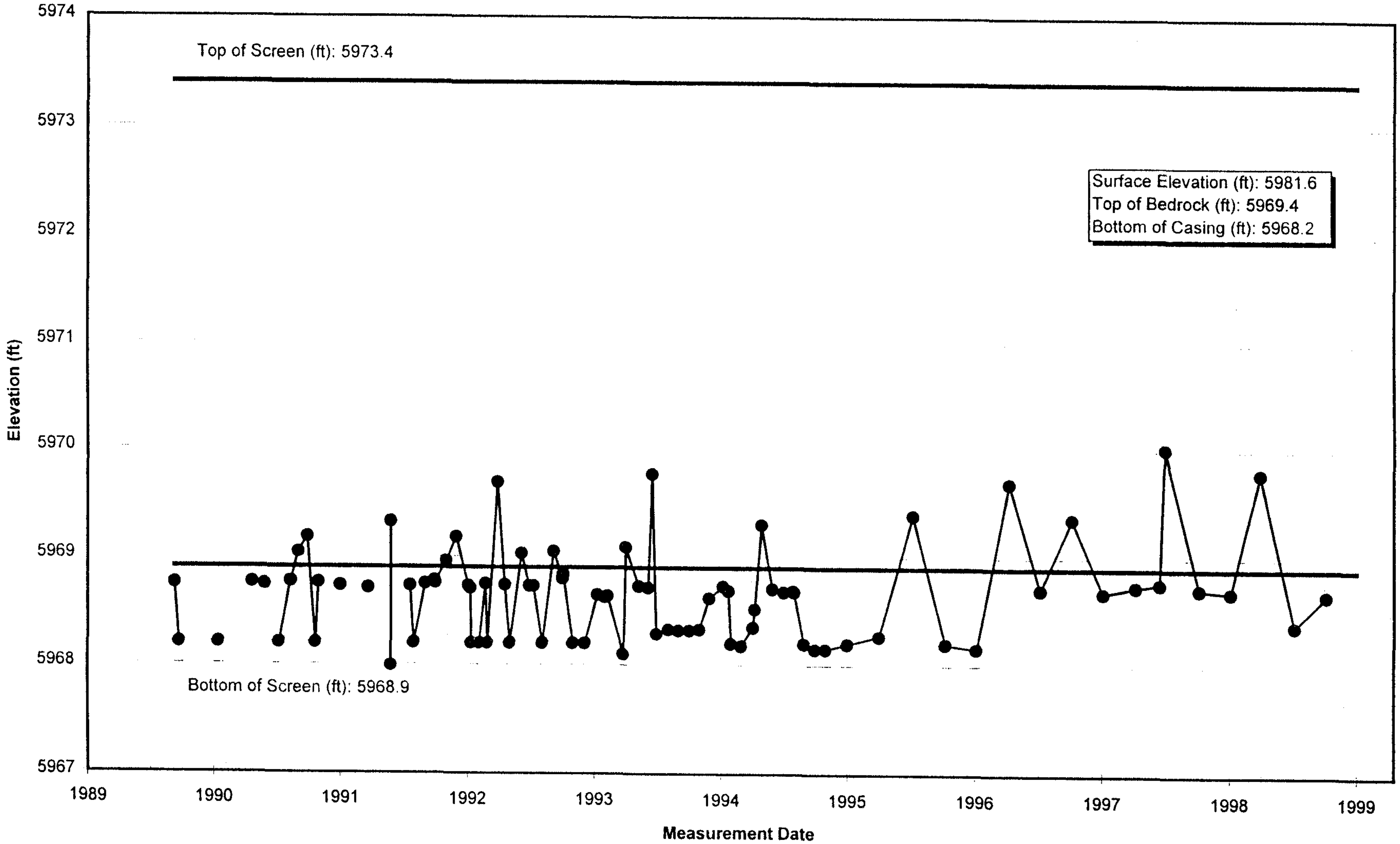
Hydrograph P114389



358
361

S20_97 4389 9/22/99

Hydrograph P209289



359
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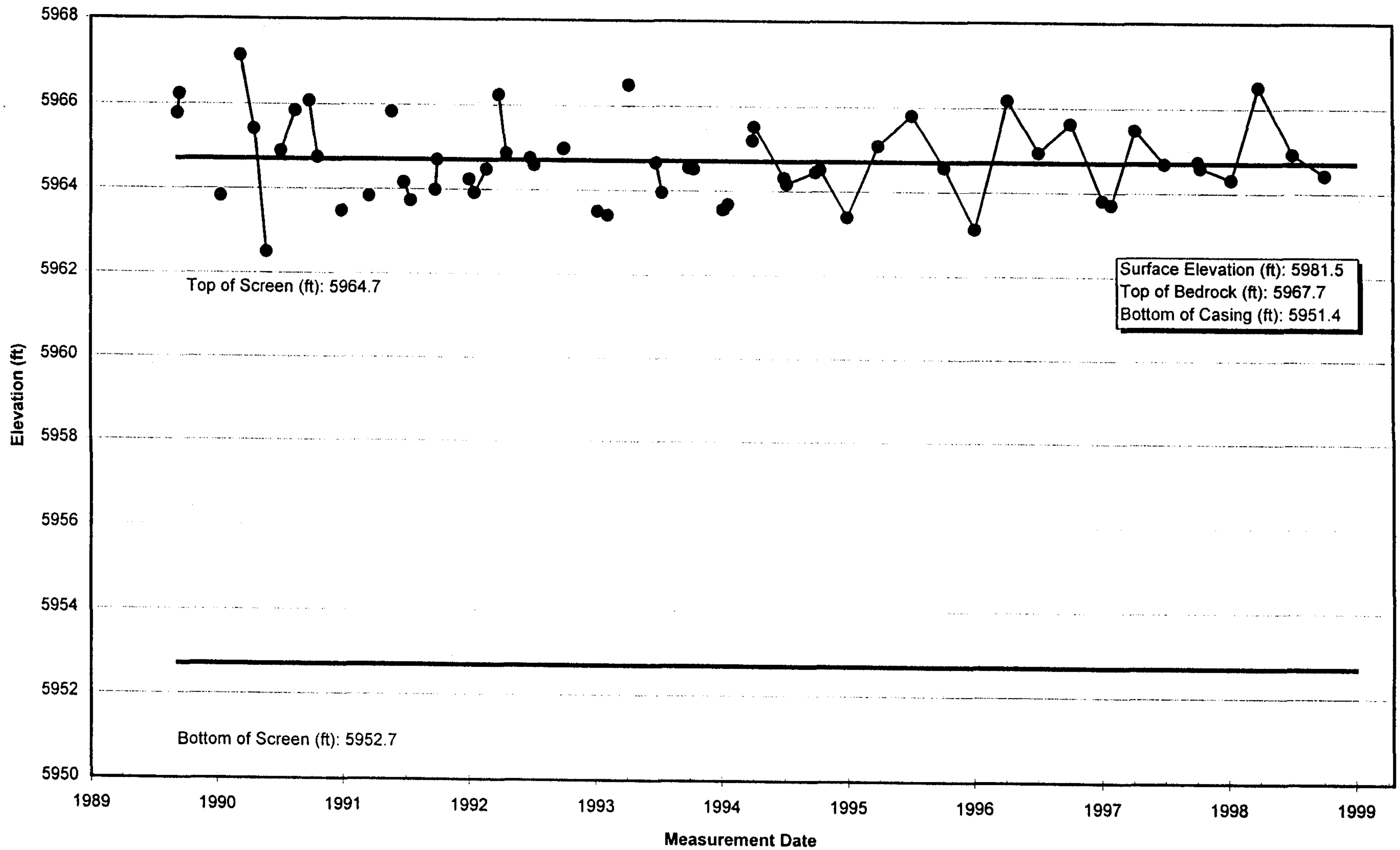
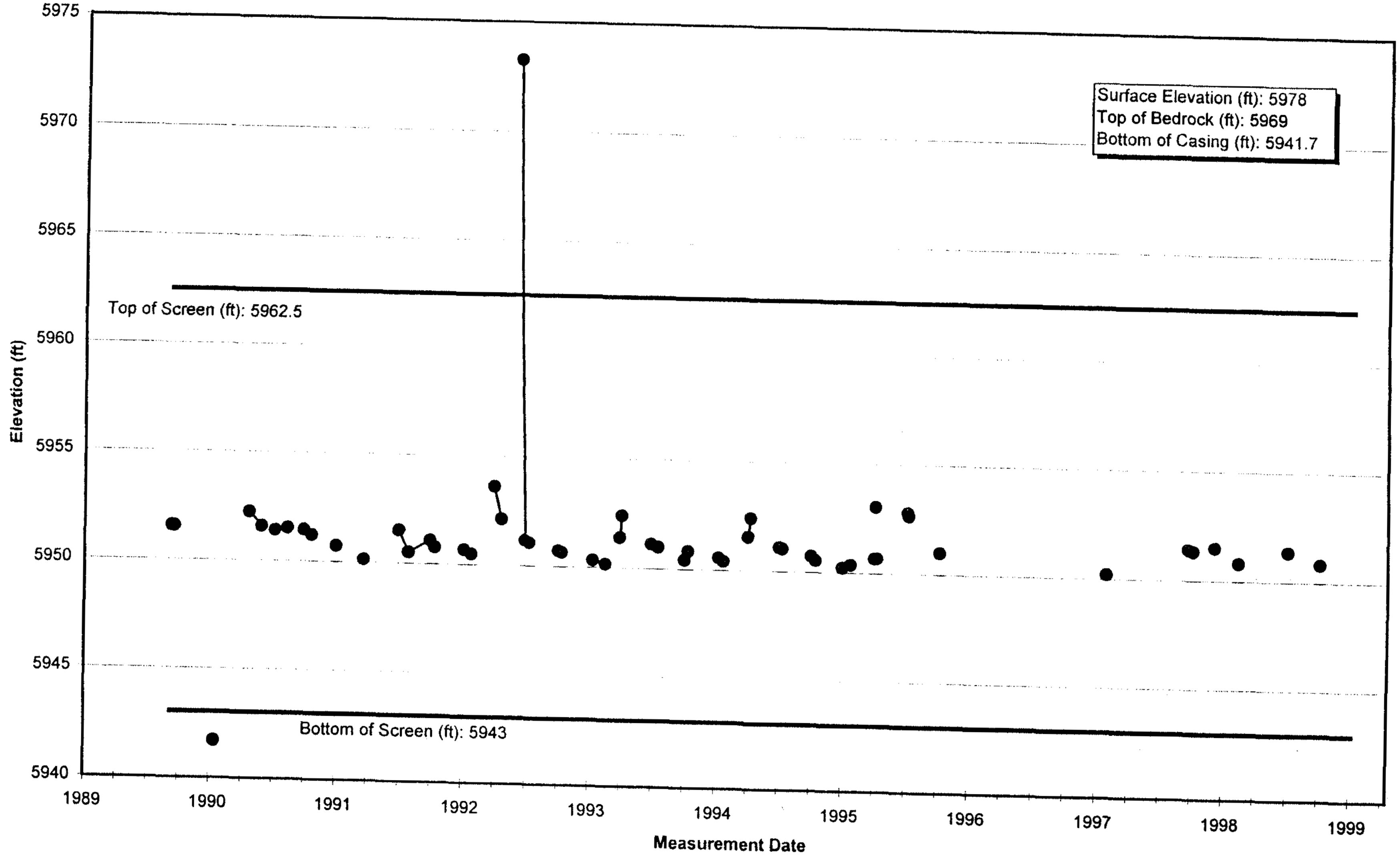


360
365

S21_9 9389 9/22/99

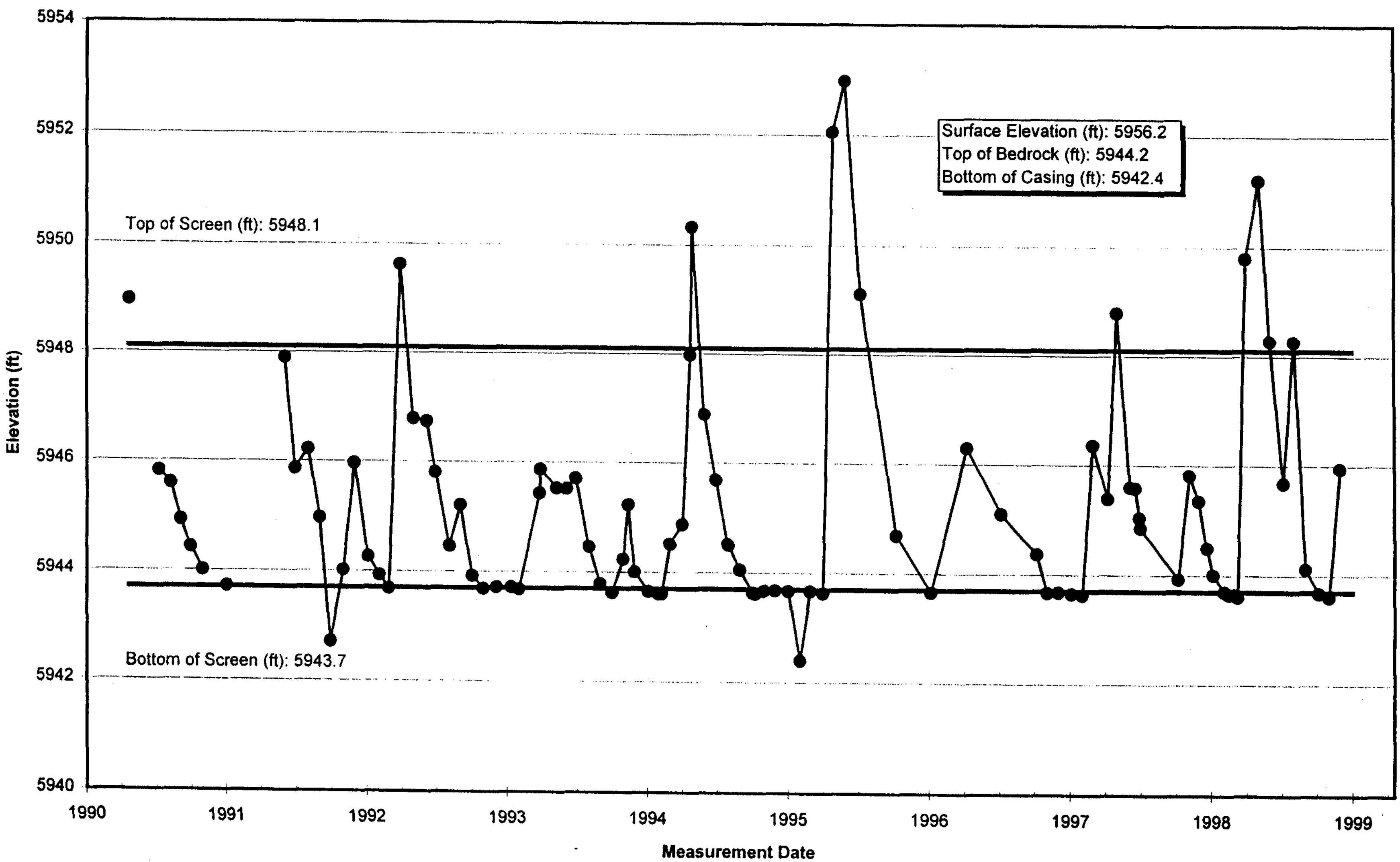
Hydrograph P209489



S21_97.xls P209489 9/22/99

361/369

Hydrograph P218389



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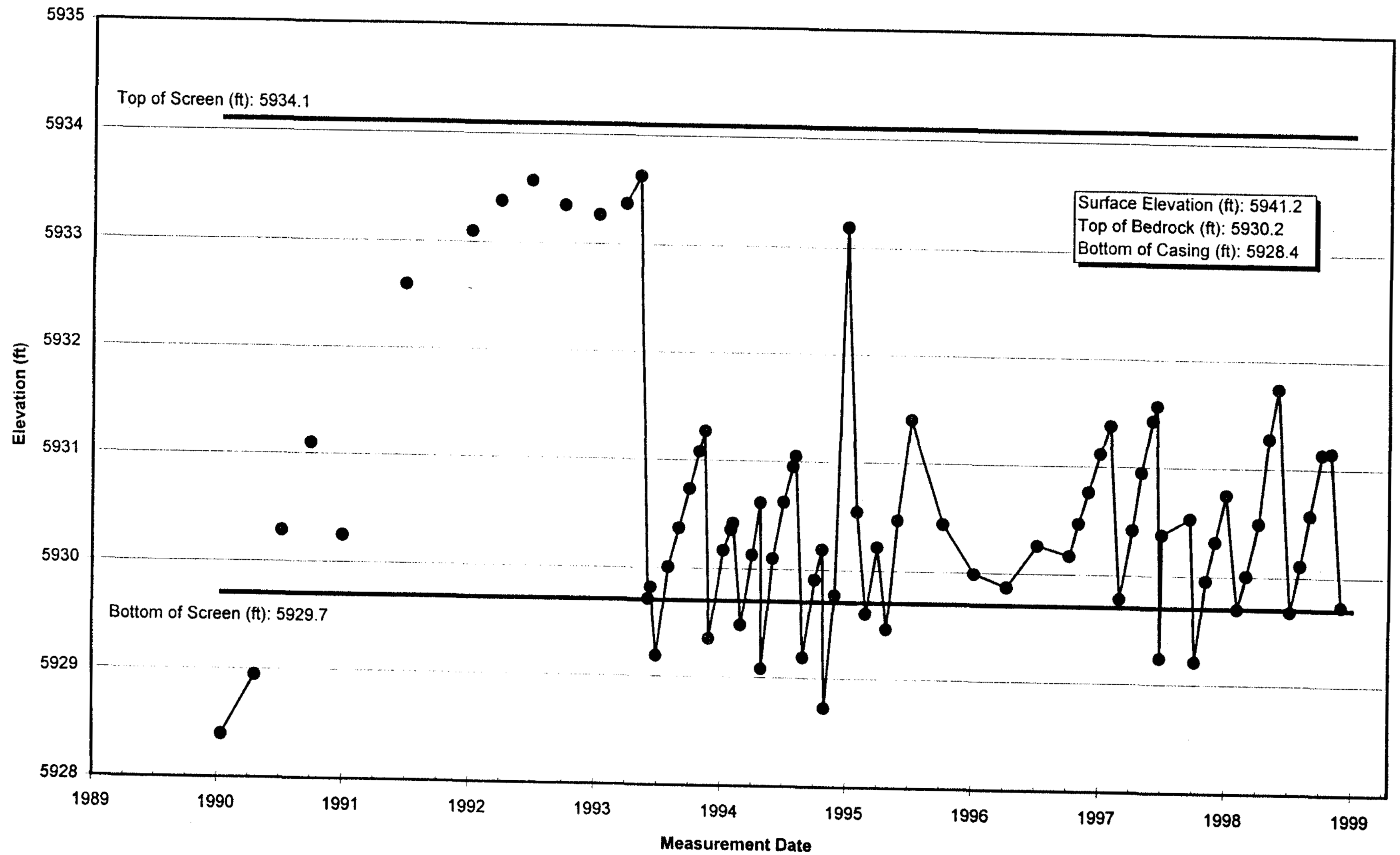
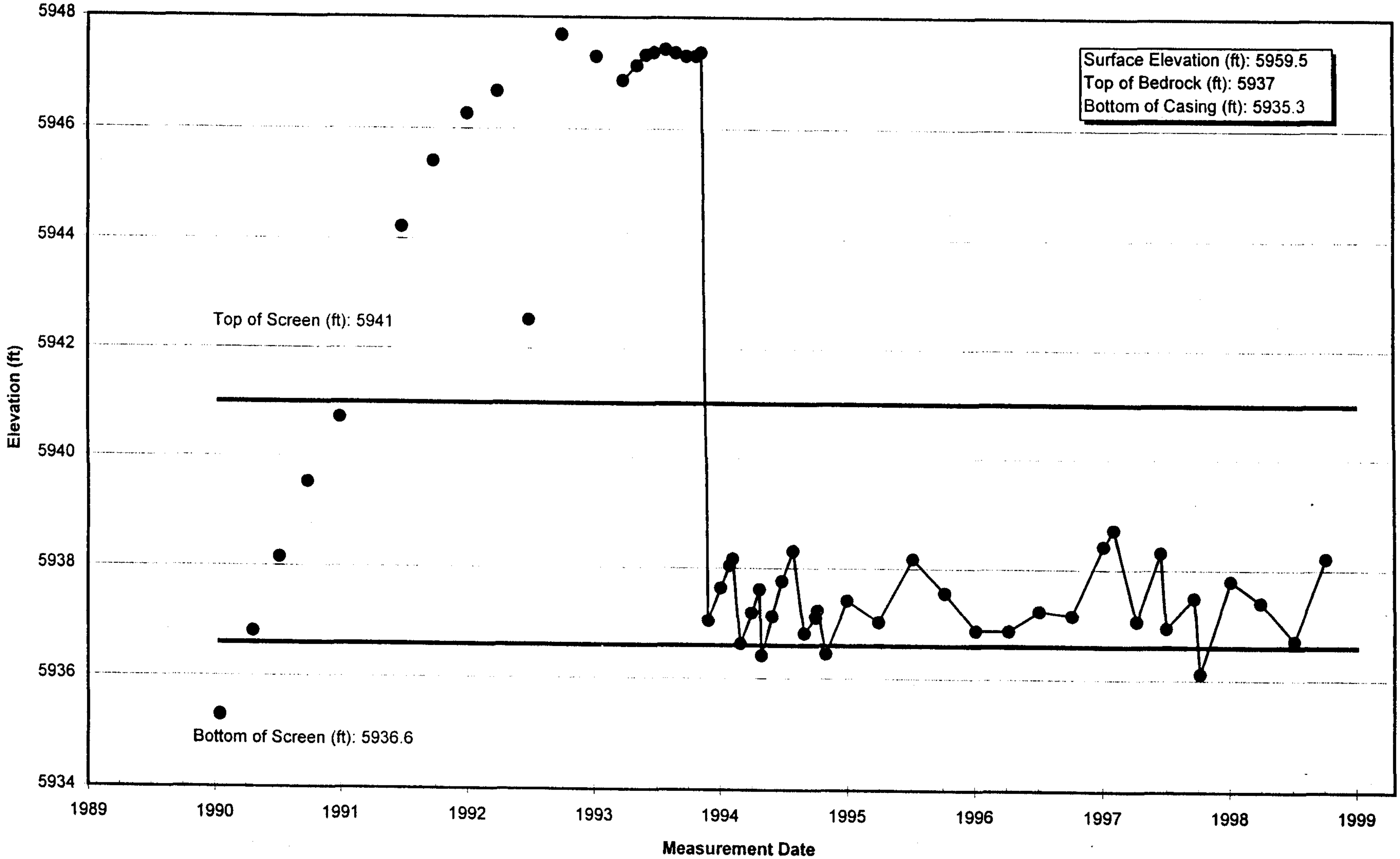


S21_97.xls P219189 9/22/99

363
366

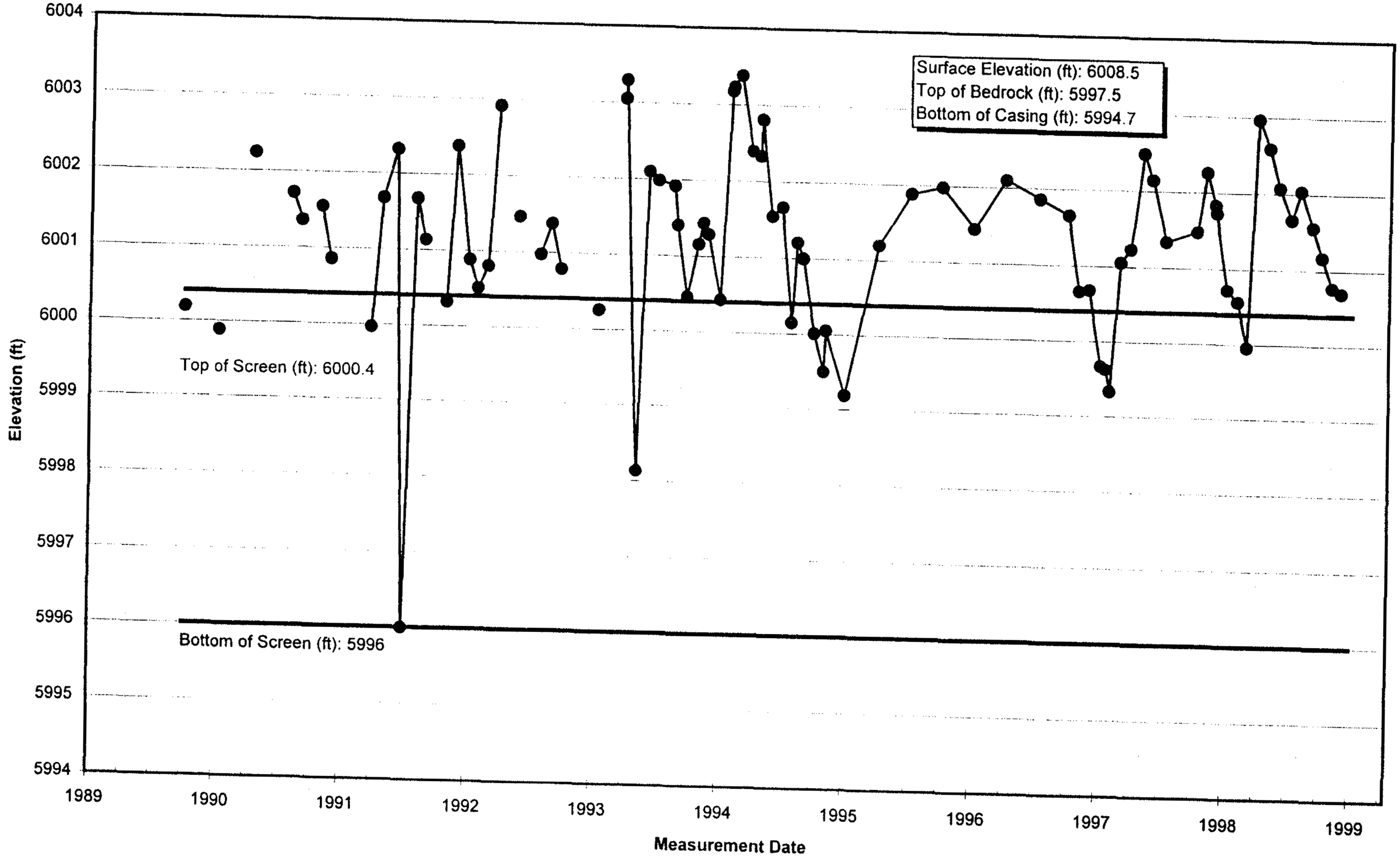
Hydrograph P219489



S22_9[illegible]9489

364
~~367~~

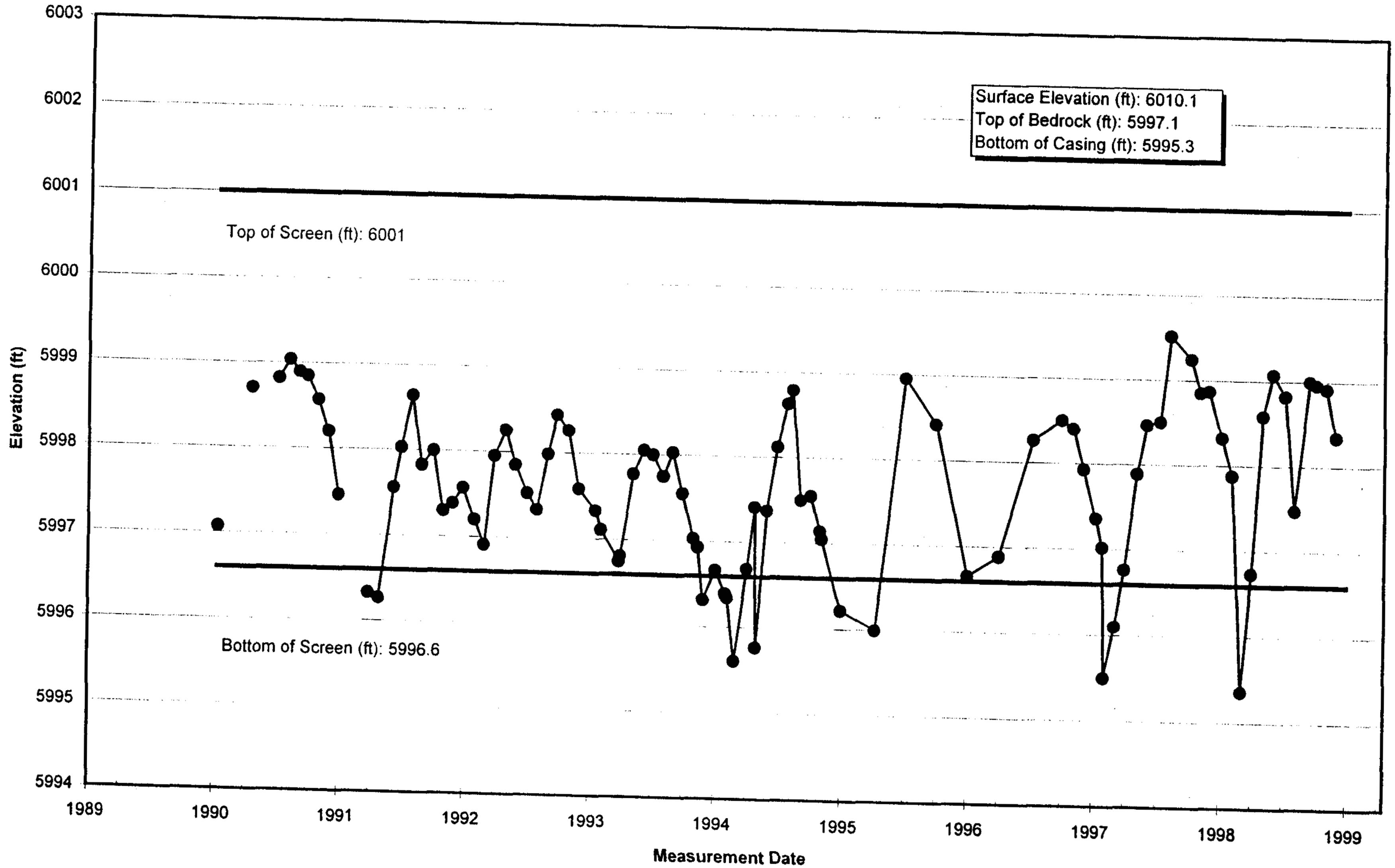
Hydrograph P313589



365
368

S22_97.xls P313589

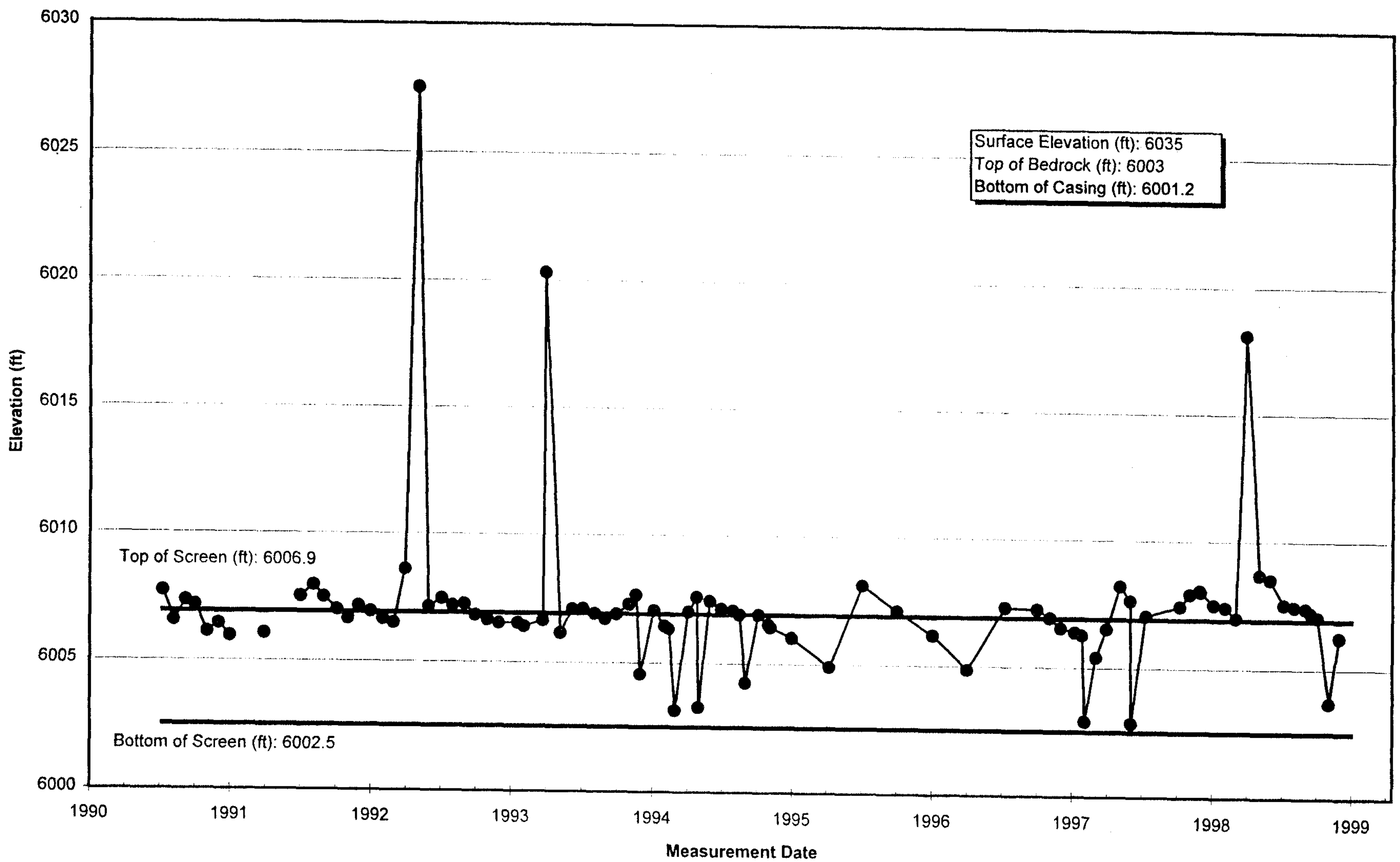
Hydrograph P314289



S22_97 4289

3~~65~~ 366

Hydrograph P416689



S22_97.xls P416689 9/22/99

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370

Appendix C.1

1998 Borehole Logs

~~371~~ 368

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 00198
Location - North: ______ East: ______
Date: 3/17/98
Geologist: Jim Cox / Earl Tuta
Drilling Equip.: Geoprobe - continuous

Surface Elevation: ______
Area: 905 PAD / RYAN'S PIT
Total Depth: 10.0
Company: IT CORP Project No.: ______
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0	0							0		0-0.35' CLAYEY SILT w/ SAND V. DK. GRAY (10 YR 3/1) SOME GRANITIC PEBBLES MOIST, w/ GRASS, ROOTS, WORM
	RUN #1	2.0'					GC to SC	1		0.35'-0.5' GRAVEL GRANITIC PEBBLES SUBROUNDED, w/ CLAYEY SILT w/SAND AS ABOVE. MOIST
								2		0.5-2.0 CLAYEY SILT, V. DK GRAYISH BROWN (10 YR 3/2) SOME SAND AND GRANITIC PEBBLES, SUBANGULAR TO SUB ROUNDED, MOIST, SOFT
	4.0	50%						3		2.0' to 4.0' NO RECOVERY ~~CORE STUCK IN BARREL~~
Box 1 of 2 0.0-12.0	RUN #2	0% RECOVERY						4–7		4.0' to 8.0' NO RECOVERY CORE STUCK IN BARREL. (POSSIBLE CONTACT IN THIS INTERVAL CLAYEY SILT AT 8.3-8.6 IS POSSIBLY SLOUGH*) JL
	8.0						GC	8		8.0-8.3' SLOUGH. 8.3-8.6 CLAYEY SILT, V. DK BROWN (10 YR 2/2) SOME V. F SAND, GRANITIC PEBBLES, SUB ANGULAR, MOIST, SOFT *
	RUN #3	2.9'						9		8.6-10.3 - CALICHE LENS AT CONTACT w/ABOVE TOP OF BEDROCK - ~~SILTSTONE~~ SILTY CLAYSTONE, BROWNISH YELLOW (10YR 6/6) V. MOTTLED, w/ CALICHE. DRY, HARD

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: CO198
Location - North: East:
Date: 3/17/98
Geologist: Jim Cox / Z. Tuta
Drilling Equip.: Geoprobe
Surface Elevation:
Area: 903 PAD / RYAN'S PIT
Total Depth: 18.0'
Company: IT CORP
Project No.: ~~774145~~ 774115
Sample Type: continuous

EG&G LOGGING SUPERVISOR APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 1	Run #3 11.0	2.5' 100%	SAMPLE 14.2-14.5					10		10.0-10.5 SILTY SANDSTONE, L. GRAY (10 YR 7/2). FINE SUBROUNDED TO ROUNDED. V. POORLY CEMENTED. NO VOCS.
								11		10.5-10.9 - SILTSTONE, YELLOWISH BROWN (10 YR 5/6) W/ CLASTS, LIMONITIC AND MANGANITIC STAINING, NO VOCS.
	Run #4	0.7'								~~11-11.3 SLOUGH~~
12.0	12.0	70%						12		11.3-12.0 SILTSTONE, YELLOWISH BROWN (10YR ~~6/3~~ 5/6)
										12.0-14.5 SANDSTONE ~~(ARAPAHOE)~~ PALE BROWN (10 YR 6/3) V. FINE, SUBROUND TO ROUND, SILTY NOT WELL CEMENTED SOME LIMONITIC STAINING, ~~FINE ING UPWARD~~.
								13		14.5-14.6 - FINE-MED ~~COARSE~~ GRAVEL.
	Run #5	4.0' out of 3.0' Run	14.2					14		14.6-15.3 - ~~MED GRAVEL LENS IMBEDDED TO~~ SILTSTONE W/CLAY, BROWNISH YELLOW (10 YR 6/6) SOME SAND, FINE GRAINED, MASSIVE
Box 2 of 2	15.0	133%	sample -001 -002 -003							15.3-15.4 MED GRAVEL LENS IMBEDDED IN SILTSTONE MATRIX.
								15		15.4 - SILTSTONE AS ABOVE.
			RIN 98A1633					16		15-18 - NO RECOVERY CORE STUCK IN BARREL.
	Run #6	3.5' out of 3' Run						17		IN THE SILTSTONE WE ARE GETTING MORE THAN 100% RECOVERY.
18.0	18.0	120%						18		
	TD = 18.0									TD = 18.0'

SOIL SAMPLE

RIN #	EVENT #	SAMPLE # RS
98H1433	001 -	-001 -002 VOC -003 ISO

NOT COMPLETED AS A WELL. *

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: C0198A
Location - North: ______ East: ______
Date: 3/12/98
Geologist: J. Cox / J. Tuta
Drilling Equip.: Geoprobe
Surface Elevation: ______
Area: 903 PAD / RYAN'S PIT
Total Depth: 16.0
Company: IT CORP
Project No. 774115
Sample Type: continuous.

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0	0.0 Run #1 4.0	4.0 (100 %)						0–4		0.0 - 3.4 CLAYEY SILT, v. dark gray (10 YR 3/1) med. pebbles, subrounded at 0.3', w/roots to 0.5', med. pebble, subrounded at 2.9; moist
Box 1 of 3										3.4 - 4.0 CLAYEY SILT, (less clay), grayish brown (10 YR 5/2), some caliche, less moist than above.
	4.0 Run #2 6.0	2.4 (120 %)						4–6		4.0 - 4.3 slough ~~4.3 - 6.4~~ 4.0 - 6.0 CLAYEY SILT, grayish brown (2.5 Y 5/2), some sand, fine gr., subrounded; some caliche with caliche increasing from 6.0 - 6.4'
8	6.0 Run #3 8.0	2.7 (135 %)						6–8		6.0 - 6.2 slough 6.2 - 8.0 CLAYEY SILT (as above) grayish brown (2.5 Y 5/2) some sand, fine grained subrounded, some caliche, DRY.
Box 2 of 3	8.0 Run #4 10.1	3.3 (165 %)						8–10		8.0 - 8.2 slough ~~8.2 - 9.2~~ 8.0 - 9.2 CLAYEY SILT (As above) 9.2 11.2 TOP OF BEDROCK ~~9.2 - 11.2~~ CLAYSTONE, darkish yellow brown (10 YR 4/6), w/ dark clasts, limonitic staining, MOIST

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 00198A

Location - North: ______ East: ______

Date: 3/17/98

Geologist: Jim Cox / [illegible]

Drilling Equip.: Geoprobe

Surface Elevation: ______

Area: 903 PAD / RYAN'S PIT

Total Depth: 16.4

Company: IT CORP

Project No.: ______

Sample Type: continuous

EG&G LOGGING SUPERVISOR

APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3	RUN #5	2.0' 100%						10–11		10.0 - 10.2 slough; 10.2 - ~~11.8~~ 11 claystone as above.
								11–12		11.8 → H. PEBBLE COATED W/ SILT & V. FINE SAND SUBROUNDED
	12.0									11.8 - ~~12.2~~ 11.8 SANDSTONE ~~(ARAPAHOE)~~ Pale Brown (10YR 6/3) V. FINE, SUBROUNDED TO ROUND, SILTY, NOT CEMENTED, SOME LIMONITIC STAINING
	RUN #6	2.5' (125%)						12–14		12.0 - 12.2 - SLOUGH; ~~12.2~~ 12 - ~~14.6~~ 14.4 - SANDSTONE AS ABOVE.
14.5	14.0							14–15		~~14.6~~ 14.4 - ~~14.8~~ 14.6 - SANDY SILTSTONE, dark yellowish brown (10YR 4/6) fine gr. sand, rounded.
Box 3 of 3	RUN #7	2.4 (100%)	*					15–16		15.2 - 16.0 CLAYSTONE, grayish brown (10YR 5/2) w/ LIMONITIC and magnetic staining, HARD, DRY
16.4	~~16~~ 16.4									
	TD =	16.4								TD = 16.4

NO SOIL SAMPLE COLLECTED
SAMPLE COLLECT FROM
BORING 00198

* no sample collected from this borehole - use sample from borehole #00198.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

(4011-930-0134-930)(Form GT.1A)(03/01/92)

~~375~~ 372

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 10298
Location - North: East:
Date: 3/25/99
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation:
Area: 903 PAD / RYAN'S PIT PLUME
Total Depth: 12.5
Company: IT
Project No.:
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	RUN #1	1.8					CL	0–1		0.0-0.5 CLAYEY SILT, dk. br. (7.5YR3/2) root hairs abundant, f. to m. pebbles subrounded, v. moist, soft. 0.5-1.8 CLAYEY SILT, dk. yellowish br. (10YR 4/6) some caliche, v. moist, soft.
	2.0	90%	VOC / 005-014					2		2.0-2.6 CLAYEY SILT, grayish br. (2.5Y 5/2) abundant caliche, moist. soft. v. weathered.
	RUN #2	2.7	Rad Scr. / 005-013					3		2.6-4.0 TOP OF WEATHERED BR. SILTY CLAYSTONE, brownish yellow (10YR 6/6) mottled w/gray (10YR5/1). ~~moist less~~ v. moist, soft.
	4.0	135%						4		4.0-4.6 same. 4.6-4.7 Heavy caliche layer
	RUN #3	2.2	RUN# 98A1433					5		4.7-6.0 SILTY CLAYSTONE, gray (10YR5/1) less moist, soft, w/caliche, v. weathered.
	6.0	110%						6		6.0-6.4 CLAYSTONE, yellowish br. (10YR5/4) mottled, w/ iron nodules.
Box 1 of 2	RUN #4	2.2	SAMPLE 7.4-7.9					7		6.4-8.0 CLAYSTONE, gray (10YR5/1) v. weathered, abundant caliche
8.2	8.0	110%	7.9					8		8.0-8.6 CLAYSTONE AS ABOVE, v. weathered w/several slip faces w slickensides.
Box 2 of 2	RUN #5							9		8.6-10.0 CLAYSTONE, yellowish br. (10YR 5/4) abundant caliche, v. weathered.
	10.0							10		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00298
Location - North: East:
Date: 4/15/93
Geologist: Jim Cov
Drilling Equip.: geoprobe
Surface Elevation:
Area: 903 PAD/RYAN'S PIT PLUME.
Total Depth: 12.5
Company: IT Project No.:
Sample Type: continuous

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2	Run #6 12.5	2.8 1.2%						10 11 12		10.0-12.5 CLAYSTONE, yellowish br. (10YR 5/4) v. weathered, some caliche abundant smooth fracture faces (30°) w/ slickensides, manganetic staining on the surfaces, well developed caliche at 11.1
TD = 12.5										TD at 12.5

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

 (4011-930-0134-930)(Form GT.1A)(03/01/92)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 00398
Location - North: ______ East: ______
Date: 3/23/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe
Surface Elevation: ______
Area: ______
Total Depth: 16.2
Company: IT
Project No.: ______
Sample Type: continuous

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0.0 - 9.9	RUN #1	3.7						0–4		0.0-0.8 SILTY CLAY, dk. yellowish br. (10YR 3/4), some f. gr. sand, w/gravel 0.1to0.5, med. to coarse pebbles, subangular to angular. moist 0.8-1.9 SILTY CLAY, dk yellowish br. (10YR 4/6) w/ well developed caliche, MOIST, soft. 1.9-3.7 SILTY CLAY, dk yellowish br. (10YR 3/4) v. weathered, abundant caliche w/few root hairs at 2.5. MOIST
	4.0	92%						4		4.0-5.8 - Same, w/out caliche small cobble at 5.4.
	RUN #2	1.8						5		
	6.0	90%						6		6.0-7.3 same 6.8 - fine pebble, quartz, subang/subround 7.1 - fine pebble, mafic, subang/subround and root hair.
	RUN #3	2.0						7		7.3-7.7 sm. to med. cobble fractured by core process, above SANDY SILT, yellowish red (5YR 4/6) w, coarse pebble subrounded SL. MOIST
	8.0	100%						8		7.7-8.0 SILTY CLAY, dk. yellowish br. (10YR 3/4) v. weathered, some caliche SL. MOIST 8.0-9.2 Same 8.5 small pebbles - mafic & quartz.
9.9 ~~8.9~~	RUN #4	2.4						9		9.2-9.8 TOP OF WEATHERED BR SILTY CLAYSTONE, dk gy. (10YR 4/1), less weathered, some caliche, MOIST 9.8-10.0 same more weathered
Box 2 of 2	10.0	120%						10		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

#375

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: CC39B
Location - North: ______ East: ______
Date: 3/23/98
Geologist: Jim Cox
Drilling Equip.: geoprobe
Surface Elevation: ______
Area: ______
Total Depth: 16.2
Company: IT
Project No.: ______
Sample Type: continuous

EG&G LOGGING SUPERVISOR APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 9.9 - 16.2	Run #5	2.0	10.6 – 11.4					10 – 11		10.0 - 11.8 SILTY CLAYSTONE, v. pale brown (10YR 7/2) v. weathered, w/ caliche moist ~~soft~~. ~~11.6-12.0~~
	12.0	100% ~~12.0~~								
	Run #6	4.0	SAMPLE 002-004 Rad sc. -005 VOC 14.8					12 – 16		11.8 ~~12.0~~ - 12.9 CLAYSTONE, dk gr. (10YR 4/1) less weathered, sl moist. 12.9-13.7 CLAYSTONE, yellowish br (10YR 5/6) less weathered, thin caliche layer at 13.3 v. sl. moist. HARD 13.7 - 15.6 CLAYSTONE, dk gr. (10YR 4/1) not weathered heavily, no caliche, massive, some smooth fracture surfaces, MOIST. 15.6-16.2- SANDY SILTSTONE, yellowish red (5YR 4/6) w/f. pebbles, subang/subround, w/f. to c. sand, subrounded to rounded, caliche as nodules.
16.2	16.2	95%								
TD = 16.2			Run # 98A1433 SAMPLE 10.6-11.4 + 14.8							TD = 16.2 SAMPLE = USED CLAYSTONE ~~from~~ FROM 14.8 as a cap over rest of sample for seal - the capped glass jar w/ I.D.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core. accurate footage measurements not possible.
(2) Core breaks cannot be matched. accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: OC498
Location - North: ______ East: ______
Date: 3/25/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation: ______
Area: 903 PAD ~~EXAN~~ SDT/PLUME
Total Depth: 14.0
Company: ITCORP
Project No.: ______
Sample Type: Continuous

EG&G LOGGING SUPERVISOR

APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2	RUN #1	1.8					MH-ML	0–1		0.0-0.4 CLAYEY SILT, dk br (7.5R 3/2) abundant fine roots v. moist 0.4-1.8 - CLAYEY SILT, dk ~~yellowish~~ br. (7.5 R 3/4) roots less abundant, some fine pebbles subround. V. MOIST.
	2.0	90%						2		1.8-2.0 NO RECOVERY
	#2	1.8					MH-ML	3		2.0-3.8 CLAYEY SILT - dk yellowish br. (10 YR 4/4) massive, occassional root (2.4) occassional f. to m. pebbles, subrounded, caliche begins at 3.2, some fine sand moist to v. moist.
	4.0	90%						4		3.8-4.0 NO RECOVERY
							ML	5		4.0-5.1 SANDY SILT, yellowish red (5 YR 4/6) weathered, some v. fine pebbles fine to med. pebble (mafic) at 4.9. v. sl. moist
	#3	2.2								5.1-6.0 SILTY CLAY, yellowish brown (10YR 5/3) abundant caliche, weathered, sl. moist w/ f. pebble layer at 5.5 (subround).
	6.0	110%						6		6.0-8.0 SILTY CLAY, grayish br (2.5YR 5/2) caliche nodules abundant. w/ med. pebbles (mafic) at 6.3 and 7.3 coated w/ caliche hard, only v sl. moist. w/ f. gr sand.
	#4	2.3					CH	7		
	8.0	115%		30				8		8.0-9.7 Same w/ slickensides at 8.4 & 9.6. Some f. pebbles at 9.5.
9.0	#5	2.0						9		9.7-10.0 TOP OF WEATHERED BR. CLAYSTONE dk yellowish br (10YR 4/4) w/ darker clasts no sand, no pebbles, harder. DRY.
Box 2 of 2	10.0	100%						10		

NOTES: General: USCS is modified for this log as follows:
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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 00498
Location - North: ______ East: ______
Date: 3/25/98
Geologist: Jim Coy
Drilling Equip.: Geoprobe
Surface Elevation: ______
Area: 903 PAD / RYAN'S PIT
Total Depth: 14.0
Company: IT CORP Project No.: ______
Sample Type: continuous

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2								10		10.0-10.3 same
										10.3-10.5 same w/ abundant caliche, med pebble, fresh fracture, likely not in place.
	#6	22	11.0					11		10.5-11.5 CLAYSTONE AS ABOVE. less caliche w/ limonitic staining.
			006-016 -017							11.5-12.0 same w/ abundant caliche ~~getting drier~~
	12.0	110%	11.6					12		12.0-12.8 same
	#7	27	006-016 Rad Scr -017 VOC					13		12.8-13.3 same w/ less caliche and abundant iron staining
										13.3-~~13.7~~ 13.7 same w/ caliche
14.0	14.0	135%								13.7-13.9 CLAYSTONE, dk yellowish br. (10 YR 3/4) V. DRY
TD=14.0			SAMPLE 11.0-11.6 Rin# 98A1433					14		13.9-14.0 CLAYSTONE, grayish br (10YR 5/2) w/ limonitic staining
										TD 14.0

Soil Sample 11.0-11.6
Rin # 98A1433
006-016
-017

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 0C598
Location - North: ______ East: ______
Date: 3/24/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation: ______
Area: 903 PAD/RYAN < PIT PLUMES
Total Depth: 20.0
Company: IT CORP Project No.: ______
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	Run #1	0.9					CH/OH			0.0-0.9 SILTY CLAY, dark yellowish br. (10YR 3/4) w/ f. to m. gr sand, subrounded to rounded, w/ common roots (fine) to 0.3. V. MOIST
	2.0	45%						1		0.9-2.0 - NO RECOVERY
	#2	2.2					CH	2, 3		2.0-3.5 SILTY CLAY, dk. yellowish br. (10YR 4/6) w/ some m. to c. pebbles subangular to sub rounded, syenitic. MOIST. 3.5-3.8 small cobble, quartzite, w/ fresh angular fractures from probe. 3.8-4.0 SILTY CLAY, dk yellowish br. (10YR 4/6), w/ m to c. gr. sand, w/ pebbles, f. to c., subangular to subround, MOIST
	4.0	110%						4		
Box 1 of 3	#3	2.2					CH/CL	5		4.0-5.4 CLAY, dk grayish br (2.5Y 4/2) massive, mottled w/ limonitic staining, w/ caliche nodules, occasional f. pebbles subangular. MOIST.
	6.0	110%						6		5.4-6.0 ~~TOP OF WEATHERED BEDROCK~~ CLAYSTONE, grayish brown (10YR 5/2) mottled, limonitic staining heavy caliche layer at 5.4. MOIST. CALICHE LAYER APPEARS V. WEATHERED.
	#4	2.4						7		6.0-8.0 same, w/ caliche zones at 6.2 and 6.8, limonitic staining minimal from 7.0-7.5, massive. MOIST. — at 8.0' med. cobble, fresh frac. slough
	8.0	120%						8		
9.0	#5	2.0						9		8.0-10.0 - SANDY SILT~~STONE~~, dk reddish br. (5YR 3/4) ~~w/ silt~~ massive, MOIST fresh cobble fracture at 9.5 uncertain if in place.
Box 2 of 3	10.0	100%						10		

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011-930-0134-930 Form GT.1A (03/01/92)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 00598
Location - North: East:
Date: 3/24/98
Geologist: [illegible]
Drilling Equip.: Geoprobe
Surface Elevation:
Area: 903 PAD RYANS PIT PLUME
Total Depth: 20.0
Company: IT Corp
Project No.:
Sample Type: continuous

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3	#6	2.7	004-010 Rad Scr. -011 VOC					11		10.0-12.0 same, w/ small cobble at 11.3 fresh fracture MOIST.
	12.0	135%						12		12.0-14.0 same moist
	#7	2.5						13		
	14.0	125%	14.0					14		14.0-15.9 same, sample 14.0-14.6
	#8	2.9	004-010 -011 / 14.6					15		
16.0	16.0	145%						16		TOP OF WEATHERED BEDROCK 15.9-16.0 SILTY CLAYSTONE, dk grayish br. (2.5 Y 4/2) w caliche, moist. 16.0-18.0 same w/ abundant caliche from 17.5-18.0 MOIST.
Box 3 of 3	#9	2.7	SAMPLE 14.0-14.6 RIN# 98A1433					17		
	18.0	135%						18		18.0-19.0 same SL MOIST.
	#10	2.8						19		19.0-20.0 gradational change from sandy SILTSTONE to CLAYSTONE yellowish br (10YR 5/6) changing to reddish br. (5 YR 4/4) at 19.5 DRY. REFUSAL AT 20.0.
20.0	20.0	140%						20		

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00691
Location - North: East:
Date: 3/23/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation:
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 19.2
Company: IT Project No.:
Sample Type: Continuous

EG&G LOGGING SUPERVISOR APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0.0-10.0	0.0 Run #1 2.0	0.2'						0–2		0.2' Rock jammed in core tip except for rock/ no recovery.
	Run #2 (2.0–4.0)	2.0'					CH	2–3		2.0-2.3 - SILTY CLAY, dark yellowish brown (10YR 4/4), some sand, f.gr.; some v.f. rounded pebbles, some caliche nodules. v/s moist
							ML	3–5.4		2.3-2.9 - SILTY CLAY, dk. yellowish br. (10YR 4/6), minor sand, some pebbles, med. subrounded. w/roots to 2.4. moist.
										2.9-4.0 - SANDY SILT - yellowish brown (10YR 5/4) sl. cemented, caliche, some fine pebbles. sl. moist.
	4.0 Run #3 6.0	2.0		30°						4.0-5.4 same more massive, w/ some med. pebbles subrounded and iron ~~Sch~~ staining.
	6.0 Run #4 8.0						CL	5.4–10		5.4-6.0 silty clay, brown (10YR 4/3), w/ less caliche and slickensides (from drilling?) w/ coarse cobble at 5.7 crushed during drilling (angular).
										6.0-7.7 silt clay, brown (10YR 4/3) w/ v.f. to coarse pebbles, some crushed in extraction. moist
										7.7-8.0 - SILTY CLAY dark grayish br. (2.5Y 4/2) w/ occassional f. pebble subrounded. moist
	8.0 Run #5 10.0									8.0-10.0 - silty clay dk grayish br. (2.5Y 4/2) moist, mottled, w occasional f. pebble and iron staining.
10.0	10.0							10		TOP W. BK at 10.0

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00698
Location - North: ______ East: ______
Date: 3/23/98
Geologist: Jim Cox
Drilling Equip.: geoprobe
Surface Elevation: ______
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 18.2
Company: IT Project No.: ______
Sample Type: continuous

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
								10		TOP OF WEATHERED BEDROCK
10.0	Run #6	2.3	Rad Scr. VOC					10–11		10.0-12.0 SILTY CLAYSTONE, d. grayish br. (2.5Y 4/2), mottled, some limonitic staining, some caliche, w/maganetic staining on slickensides at 10.1, moist.
	12.0	115%						12		12.0-13.5 Same
	Run #7	2.0	003-007 -006					13		13.5-~~13.8~~ 14.0 grading into SANDY SILTSTONE v. f. gr sand well rounded, v. sl. moist. sand increasing w/depth
	14.0	100%	13.8 SAMPLE 14.7					14		14.0-14.6 - SANDY SILTSTONE, yellow (10 YR 7/8) v. fine sand, well rounded
	Run #8							15		14.6-14.9 SILTY CLAYSTONE, yellowish br. (10 YR 5/2) mottled, limonitic staining. 14.9-15.2 same w/ abundant IRON STAINING 15.2-16.0 same w/ abundant caliche
	16.0							16		16.0-18.2 - SANDY SILTSTONE, gray (10 YR 5/1) v.f. gr. sand, caliche throughout. DRY.
Box 2 of 2 10.0-18.2	Run #9		RIN# 98A1433					17		
18.2	18.2							18		
TD = ~~18.~~ 18.2										TD = 18.2

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 00798
Location - North: ______ East: ______
Date: 3/24/98
Geologist: Jim Cox
Drilling Equip.: Geo Probe

Surface Elevation: ______
Area: 903 PAD / RYAN'S PIT PLUME
Total Depth: 14.1
Company: IT CORP   Project No.: ______
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL ______   DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	RUN #1	1.8	D07-019 Rad Scr -020 VOC -021 (ISO TOPE)				OH/CH ~~SM~~	0–1		0.0-0.8 - CLAY LOAM, v. dk grayish br. (10YR 3/2), abundant roots, occassional med. pebble - v. moist. 0.8-1.8 - ~~SANDY~~ SILTY CLAY LOAM, dk. yellowish br., (10YR 3/6), occassional root, occassional fine pebble, moist.
		90%					NO RECOVERY			
	#2	1.9					CH	2–3		2.0-3.1 - ~~SA~~ SILTY CLAY, dk yellowish br. (10YR 3/6) occassional caliche, moist. 3.1-3.9 Sandy clay ~~loam~~, dk yellowish br. (10YR 3/6) occassional fine pebble subrounded. moist
	4.0	95%					~~OH~~ CH			NO RECOVERY
	#3	2.9	Rin# 98A1433				CL	4–5		4.0-5.0 - SILTY CLAY, dk yellowish br. (10YR 3/6) occassional fine pebble subround to subangular some minor caliche. at 5.0 thin caliche layer.
	6.0	145% ~~150~~						5–6		5.0-6.0. TOP WEATHERED BR. SILTY CLAYSTONE, dk grayish br. (2.5Y 4/2) mottled, limonitic staining occassional f. pebble not in place. minor caliche, moist
Box 1 of 2	#4	~~2~~ 4	SAMPLE 9.0-10.0					6–8		6.0-8.0 - Same.
	8.0	20%								
		2.3	9.0 D07-019 -020 -021 10.0					8–10		8.0-8.3 Same. 8.3-10.0 Same v. weathered w/ abundant caliche soft.
9.8 Box 2	10.0	115%								

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(4011-930-0134-930) Form GT.1A (03/01/92)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00798
Location - North: East:
Date: 3/26/98
Geologist: DMcCoy
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 14.1
Company: IT CORP Project No.:
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2		2.6						10		10.0-10.3 - SANDY CLAYSTONE ~~SILTY SANDSTONE~~, light olive br. (2.5Y 5/6) v.f.gr. sand moist.
								11		10.3-10.3 SILTY CLAYSTONE, D. grayish brown (2.5Y 4/2), mottled, limonitic staining, sl. moist.
	12.0							12		10.3-12.0 CLAYSTONE, gray (10YR 5/1) w/ iron staining, v. dry, blocky.
		2.6						13		12.0→13.8 Same
14.1	14.1							14		13.8-14.1 - SILTY SANDSTONE, light brownish gray (10YR 6/2), bedding planes, v fine gr. to fine gr sand, dry.

TD=14.1

TD = 14.1

Soil SAMPLE Rin #	Event #	Sample #	
98A1433	007 -	-019	RS.
		-020	VOC
		-021	150

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF ___

Borehole Number: 00598
Location - North: ______ East: ______
Date: 3-27-98
Geologist: D GRAVELDING
Drilling Equip.: GEOPROBE

Surface Elevation: ______
Area: 903 PAD RYAN'S PIT
Total Depth: 16.1 FT GRADE
Company: IT CORP Project No.: ______
Sample Type: CONTINUOUS

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0 Box 1 of 2	0915 0-2 FT	RECOVERY 1.5 FT						0-2		SOIL HORIZON SILTY CLAY, DK BROWN (7.5YR 3/2) GRADING TO (7.5YR 4/4) WITH 1.5-2' DEPTH, SOME ROCK FRAGS LARGEST 1-INCH V. ANGULAR, ROOT FRAGS SL MOIST
	0923 2-4 FT	RECOVERY 0.9 FT						2-4		SILTY CLAY MATRIX, LARGE ROCK FRAGS V. ANGULAR. POOR RECOV DUE TO ROCKS, DRY — NO RECOVERY — TOP OF WEATHERED BEDROCK
	0927 4-6 FT	1.5 FT RECOVERY						4-6		CLAYSTONE, LIGHT OLIVE BROWN (2.5Y 5/4) MOTTLED W/ WITH CALICHE ZONES, V. DENSE, DRY 5.5-6.0 - NO RECOVERY
	0939 6-8 FT	RECOVERY 2.05 FT						6-8		SAME AS ABOVE
9.5 Bot 2 of 2	0945 8-10 FT	RECOVERY 2.3 FT						8-10		SAME AS ABOVE WITH A COLOR CHANGE YELLOWISH BROWN (10YR 5/6) FROM ~ 8.6-9.0' BACK TO LT OLIVE BRN (2.5Y 5/4)

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 00898
Location - North: ____ East: ____
Date: 3.27.98
Geologist: D. Gravoldung
Drilling Equip.: Hurricane Geoprobe

Surface Elevation: ____
Area: 403 Pad/Ryans Pit
Total Depth: 16.1 FT GRADE
Company: IT Corp
Project No.: ____
Sample Type: Continuous

EG&G LOGGING SUPERVISOR APPROVAL ____ DATE ____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2	0956 10-12	Recovery 3.0 FT						11		10-11 SAME AS ABOVE WITH 11 - SANDSTONE V. FINE SAND SOME SILT light Yellowish Brn (10YR 6/4) Well sorted, Sl moist.
	1005 12-14	Recovery 2.5 FT	Rad Scr 13.0 VOC 008-022 -023					12, 13		SAME AS ABOVE
	1012 14-16 FT	Recovery 3.0 FT	14.0 Rin# 98A1433					14, 15		SAME AS ABOVE 15.8-16 CLAYSTONE WEATHERED BRN, Yellowish Brn (10YR 5/4), IRREGULAR BEDDING PLANES Sl moist.
16.0								16		

TD = 16.0

TD = 16.0

Soil Sample
Rin # 98A1433
EVENT 008 — 022 Rad Scr.
— 023 VOC
Sample #

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: [illegible]
Location - North: East:
Date: [illegible] 96
Geologist: [illegible]
Drilling Equip.: geoprobe

Surface Elevation:
Area: 903 PAD / RYAN'S PIT
Total Depth: 12.1
Company: [illegible]
Project No.:
Sample Type: grab.

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
							OH			0.0-0.6 - SANDY CLAY LOAM. V. DK gray (~~10YR~~ 3/1) w/ many roots & fine gravels v. wet
		1.7						1		0.6-1.7 - SILTY CLAY, w/ sand ~~and small gravel~~ fine gravel subang. to subround.
	2.0						CH	2		1.7-4.6 SILTY CLAY, dark grayish brown (2.5Y 4/2) massive, occassional fine to med pebble subangular to subround some caliche as nodules. TOP OF WBR
		2.3						3		
	4.0							4		4.6-5.3 SILTY CLAYSTONE, gray, (10YR 5/1) blocky, slight sand content increasing w/depth v. fine sand. TOP OF WEATHERED BEDROCK. MOIST. ~~INTERBEDDED W/~~
BOX 1 of 2		2.3	Rad Scr. VCC 009-025 -026					5		5.3-6.0 - SILTY SANDSTONE INTERBEDDED SANDSTONE CLAYSTON V. FINE GR. SAND ROUNDED iron nodules. w/some clay. MOIST.
	6.0							6		6.0-7.0 SANDY CLAYSTONE BLOCKY / DARK gray (10YR 4/1) V. FINE GR. SAND
		2.3	7.3 009-025 -026					7		7.0-7.2 TRANSITION ZONE SAND % increasing.
8.4	8.0		7.8					8		7.2-7.8 SILTY SANDSTONE, light yellowish brown (10YR 6/4) not blocky, not well cemented v.f. sand.
BOX 2 of 2		2.3	RIN 98A1433					9		8.0-10.0 INTERBEDDED SILTY SANDSTONE AND SANDY CLAYSTONE AS ABOVE WITH ~~CLAYSTONE~~ IRON STAINING INCREASING W/DEPTH
	[illegible]							10		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 06994
Location - North: East:
Date: 3/4/1994
Geologist:
Drilling Equip.: geoprobe

Surface Elevation:
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 12.1
Company: IT
Project No.:
Sample Type: continuous

EG&G LOGGING SUPERVISOR
APPROVAL ____ DATE ____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box #2	#6	3.0' 150%						10, 11, 12		10.0-12.0 - SILTY CLAYSTONE, V. DK. GRAYISH BROWN (2.5Y 3/2) ABUNDANT IRON STAINING, BLOCKY, DRY. MINOR V. FINE SAND.
12.1	12.1									
	TD=12.1									TD = 12.1
										BACKFILL [illegible] w/ BENTONITE CHIP

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

344388

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 01098

Location - North: ______ East: ______

Date: 4-10-98

Geologist: D. Grazzini

Drilling Equip.: Geo Probe

Surface Elevation: ______

Area: 903 Pad Lyman's Pit

Total Depth: 12.0

Company: IT Corp

Project No.: 774115

Sample Type: Push Continuous

EG&G LOGGING SUPERVISOR APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
1/2	0 - 2	0912 * 1.5' of Recovery						0 - 2		SURFACE SAMPLE SILTY CLAY REDISH BRWN (5YR 4/4) LRG GRAVEL MAX DIAMETER @ 1.1FT ROOT/PLANT FRAGS, SOFT TO MED DENSITY, SL MOIST.
	2 - 4	0919 2.2 FEET Recovered						2 - 4		SILTY CLAY REDISH BRN (5YR 4/3) SOME SAND 5% + GRAVEL 5% ROUNDED TO SUB ANGULAR, LOOSE FRAG, SL MOIST.
	4 - 6	0925 2.0 FT Recovery						4 - 6		SAME AS ABOVE INCREASE SAND CONTENT 40% LITTLE TO NO CLAY WHITE CALCITE STAINING, DRY. 5.4' LARGE GRAVEL
	6 - 8	0934 2.0 FT Recovery						6 - 8		6-8 SAME AS ABOVE FINE SAND SILT, 7.5YR 4/6 STRONG BROWN, WHITE/BUFF CALCITE STAINING. GRAVEL/COBBLES ROUNDED SUB ROUNDED.
8.8 / 1/2	8 - 10	0940 2.2 FT Recovery						8 - 10		8.8 - ROCK FRAGMENTS MIXED WITH CLAY/SILT. DRK YELLOWISH BRN (10YR 4/6) V. DENSE, DRY - SL MST SOME SUBROUNDED gravel 1/2 inch. 1%.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

387-389
388

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01098
Location - North: ______ East: ______
Date: 4-10-98
Geologist: D. Grandling
Drilling Equip.: Geo Probe

Surface Elevation: ______
Area: 903 Pad / Ryan's Pit
Total Depth: ______
Company: IT Corp Project No.: 774115
Sample Type: Continuous Split

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
2/2		0955 2.3 FT Recovery	10 / 9.0-10.5 FT / 10.4					11		10.9 FT CLAY dk grayish BRN (2.5Y 4/2) some olive BRN Mottling (2.5Y 4/4) Relic Bedding Planes, some Caliche AND Limonite Staining Dry.
12.4	12.4							12		
TD 12.4			005-013 RS / 005-014 VOC					13		~~TD = 12.4~~
			SAMPLE BIN # 98A1600							TD = 12.4

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 11496
Location - North: ______ East: ______
Date: 4/9/96
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation: ______
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 20.5
Company: IT CORP Project No.: ______
Sample Type: continuous

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
										0.0-0.5 SEVERAL LARGE COBBLES REMOVED BY HAND NOT PUSHED.
0.5	0.5						OH			0.5-0.9 SILTY CLAY LOAM, dk. br. (7.5YR 3/4) abundant roothairs, V. MOIST
	Run # 1	1.5						1		0.9-2.0 SILTY CLAY; dk yellowish br (10YR 3/4) massive
	2.0	100%					CH	2		2.0-3.6 same silty moist. MOIST
	#2	2.3						3		
										3.6-4.0 CLAYEY SILT. dk yellowish br. (10YR 4/6) BLOCKY w/caliche in fractions DRY
	4.0	115%						4		4.0-6.0 Same w/quartzite pebbles (fine-med subang.) some fresh fracs from push at 5.2', 5.4', 5.9' root at 5.9. DRY
	#3	2.1						5		
	6.0	115%					CL/ML	6		6.0-8.0 CLAYEY SILT TO SILTY CLAY strong br. (7.5YR 4/6), w/caliche hairs w/sm. to med. pebbles. Some quartzite some med. ... DRY w/sand
Box 1 of 3 0.5'-8.0	#4	2.3						7		
8.0	8.0	115%						8		8.0-10.0 Same w/ greater sand content and f.-m. pebbles subang/subround. Some caliche, heaviest 9.8-10.0. DRY
Box 2 of 3	#5	1.9						9		
	10.0									

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 01198
Location - North: East:
Date: 4/9/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe
Surface Elevation:
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 20.5
Company: IT
Project No.:
Sample Type: continuous

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
								10		10.0-12.0 same w/out pebbles, only minor caliche except at
	#6	2.0	DUP-180					11		11.0-11.4 same, heavy caliche zone v.sl.moist 11.4-11.9 same, some caliche 11.9 - caliche layer v.sl.moist
	12.0	120%								
	#7	2.5	D11-032					12		12.0-13.7 CLAYEY SILT, strong br. (7.5YR 4/6) w/sand, some caliche, v. coarse mafic pebble at 12.5 subang/subround. DRY
								13		13.7-14.0 same w/ heavy caliche
	14.0	125%	003-007 RAD SCR -008 VOC -009 ISO					14		14.0-16.0 same, w/ heavy caliche zones at 14.6 to 15.0 and from 15.5 to 16.0
	#8	2.5						15		
	16.0	125	16.0							16.0-16.1 same heavy caliche
		2.1	003-007, 008, (009) DUP 150 (01132)							16.1-16.7 gravel, f.-c. pebbles mixed in clayey to sandy silt, fresh fracs, otherwise subang/subround. abundant caliche DRY.
							OL	17		16.7-17.9 CLAY, olive br. (2.5Y 4/2) mottled, limonite staining. no coarse v. sl. moist to dry. 17.9-18.0 caliche layer at 17.9 - then as above - f. to m. pebbles - trace silts in tip.
	18.0		17.8							18.0-18.7 SANDY SILTSTONE, strong br. (7.5YR 4/6) w/ clay, v. fine gr. sand DRY
							ML	18		18.7-18.8 SILTY CLAY, l. olive br (2.5YR 5/4) w/ several f. pebbles, some caliche v. sl. moist
							CL			
		2.9	RIN#98A1600					19		18.8 TOP WEATHERED BR. CLAYSTONE, l. olive br. (2.5Y 5/4) caliche layer at 18.8 - No sand or pebbles v. sl. moist, w/ limonite staining. 19.1-20.5 CLAYSTONE, olive br (2.5Y 4/2) v. weathered, blocky v. DRY.
	20.5	145%						20.5		

NOTES: General: USCS is modified for this log as follows: TD = 20.5
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

395392

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: [illegible]1298
Location - North: ______ East: ______
Date: [illegible]
Geologist: [illegible]
Drilling Equip.: [illegible]

Surface Elevation: ______
Area: 903 PAD/RYANS PIT PLUME
Total Depth: 18.3
Company: [illegible]
Project No.: ______
Sample Type: [illegible]

EG&G LOGGING SUPERVISOR APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0							OH	0		0.0-0.4 ~~SILTY CLAY~~ LOAM, v. dk. br (10YR 2/2) ~~wet~~ abundant root hairs, some f. pebbles, wet to v. moist.
	Run #1	1.3						1		0.4-1.3. SILTY CLAY, dk. br. (7.5 YR 3/4) massive, occassional root hairs, occassional f. pebble.
	2.0	65%						2		2.0-2.4 SILTY CLAY br (7.5 YR 4/4) few root hairs, moist
	#2	2.2						3		2.4-~~4.0~~ 3.2 SILTY CLAY, strong br (7.5 YR 4/6) w/ minor f. sand caliche increasing w/ depth. sl. moist
										3.2-~~DRY~~ 4.0 SAME DRY.
Box 1 of 3	4.0	110%					CH	4		4.0-6.0 SILTY CLAY, dk yellowish br. (10YR 4/6), some mafic pebbles fine to med. subang. to sub round (4.8' to 5.0') sl. moist.
	#3	2.2						5		
	6.0	110%						6		6.0-8.0 SILTY CLAY, strong br. (7.5YR 4/4) w/ some f. to gr. sand (7.7') and some caliche nodules (6.1', 6.8') some f. mafic pebble, subround at 6.7., sl. moist.
	#4	2.4						7		
	8.0	120%						8		8.0-9.0 SILT CLAY as above w/ f. mafic pebble at 8.3, some v. f. sand. sl. moist to v. sl. moist; sand ↑ w/ depth
8.4										
Box 2 of 2	#5	2.1						9		9.0-10.0 SANDY CLAY, dk yellowish br. (10YR 4/[illegible]) v. f. gr. sand w/ abundant caliche 9.4-10.0
	10.0	105%					CL	10		

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core. accurate footage measurements not possible.
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340393

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 01298
Location - North: ______ East: ______
Date: 4/8/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe
Surface Elevation: ______
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 18.3
Company: IT Project No.: ______
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
	#6		002-004 Rad Scr - 005 VOC					10 – 11		10.0-12.0 - ~~SILTY CLAY~~ CLAYEY SILT, dk yellowish br, (10YR 4/6) v. silty, some v.f. gr. sand sl. moist; sm. mafic pebble at 11.2 w/ caliche abundant 11.5'. Sl. moist.
Box 2 of 3	#7	3.6	13.3					12 – 13		12.0 - ~~14.0~~ 13.0 same ~~caliche from~~ sl. moist. 13.3 ~~14.0~~ 14.0 / ~~Sl. moist~~ SILTY CLAY TO SANDY SILT strong br. (7.5YR) w/ f. gr. sand and f. mafic pebbles. coarsening downward. w/ Caliche 13-14 Sl. moist.
	[illegible]	180%	14.0					14		14.0-14.6 - ~~SILTY~~ SANDY SILT, st. br. (7.5YR 4/6) sand content ~~higher~~ greater than above.
	#8	1.9	RIN98A1600					15		14.6-15.8 ~~16.0~~ gravel - f. pebbles to to v. coarse pebbles subang./subround w/ fresh fracs from pushing, granitic, quartzite some mafic near ~~16.0~~ 15.8 DRY
16.0	16.0	95%						16		15.8-16.0 - CLAY, yellowish brown (10YR 5/4) heavy caliche, mottled w/ gravel from above. DRY 16.0-16.3 - same DRY
Box 3 of 3	1234 #9	2.8						17		
18.3	18.3							18		16.3 - TOP OF WEATHERED BR. SILTY CLAYSTONE, ~~yellowish~~ yellowish br. (10YR 5/4), mottled, limonitic staining no sand or pebbles observed, limonitic staining, iron staining, caliche. Caliche layer right at 16.3.
18.3	18.3	127%								

18.3 = TD

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 01398
Location - North: ______ East: ______
Date: 4/1/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation: ______
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 10.1
Company: IT Project No.: ______
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 6.0 - 9.3	Run #1	1.9	010-026 RS, 010-029 VOC, 011-031 DUP VOC					0		0.0-0.8 – SANDY CLAY LOAM, v. dark grayish brown (10YR 3/2) w/ many roots, ~~occasion~~ caliche nodule at 0.8, V. MOIST
	2.0	90%						1		0.8-1.8 CLAY LOAM, dark yellowish brown (10YR 4/6) w/ several caliche nodules, medium pebble at 1.2, ~~wet~~ subrounded, moist. Some roots.
	#2	1.7	RIN# ~~98A1100~~ 98A1433					2		2.0-3.2 Same w/ coarse pebble at 3.2, subrounded and gravel layer (med to coarse pebbles) ~~from~~ 3.6 to 3.7 fresh fractures. sub ang. to subround moist.
	4.0	85%						3		
	#3	~~0.9~~ 1.2 ~~2.3~~	4.4 010-028, 010-029 011-031 6.5					4		4.0-~~4.6~~ 5.2 – low recovery due to gravel. ~~possibly all slough~~. – gravel ~~is same~~ as above as is clay loam matrix. DRY
	6.0	~~45%~~	SAMPLE 4.4-6.5					5		RIN# 98A1433
	#4	2.3						6		6.0-6.4 – gravel ~~Same, CLAY LOAM, some caliche~~, ~~d. yellowish brown (10YR 4/6)~~ med-coarse pebbles sub angular to subround – mostly quartzite fresh fractures.
	8.0	115%						7		6.4-8.0 Top of weathered bedrock, SILTY CLAYSTONE, grayish brown (10YR 5/2) mottled, iron staining, no sand or pebbles some caliche – heavy iron staining 7.9-8.0 weathered, moist.
9.3	#5							8		8.0-8.9. SILTY CLAYSTONE grayish brown (10YR 5/2) very little iron staining. Some caliche, v weathered, moist.
Box 2 of 2	10.0							9 10.1		8.9-10.1 – same heavy iron staining. caliche sl. moist.

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

TD = 10.1 NOTE 1

348395

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 01498
Location - North: ________ East: ________
Date: 4/1/98
Geologist: Jim Cox
Drilling Equip.: geoprobe

Surface Elevation: ________
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 10.2
Company: IT Project No.: ________
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL ________ DATE ________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	RUN #1	1.8						1		0.0-1.8 SANDY CLAY LOAM - v. dk. grayish br. (10YR 3/2) w/many roots, occassional f. to m. pebble, subrounded. V. MOIST
	2.0	90%	001-001 RAD SCR -002 VOC					2		2.0-3.7 SILTY CLAY, Brown (10YR 5/3) mottled w/ grayish br. (10YR 5/2) weathered w/caliche, pebble (coarse) at 2.3 not in place. MOIST, w/limonitic & iron staining
	RUN #2	1.7						3		
	4.0							4		4.0-6.0 SILTY CLAY, grayish br. (2.5Y 5/2) v. weathered, abundant caliche, coarse pebble at 4.4 not in place. MOIST
	RUN #3	2.3	5.0 SAMPLE 5.6					5		
BOX 1 of 2 0.0-9.0	6.0	115%						6		6.0-6.4 same 6.4 - Caliche layer 6.4-7.5 TOP OF WEATERED BR. SILTY CLAYSTONE, grayish br. (2.5 YR 5/2) mottled, limonitic staining, silt content less than above, massive, w/ crystal structure at 7.4 appears calcerious MOIST.
	RUN #4	2.3						7		
	8.0	115%	RIN # 98A1600					8		7.5-8.0 SILTY CLAYSTONE, grayish br (2.5YR 5/2) iron staining, blocky less moist than above 8.0-8.5 same, only v. sl. moist.
9.0	RUN #5							9		8.5-10.2 - CLAYSTONE - grayish br. (2.5 YR 5/2) some iron staining, v. blocky DRY.
Box 2 of 2 9.0-10.2	10.2							10.2		TD = 10.2

10.2

NOTES: General: USCS is modified for this log as follows: TD = 10.2
Materials amounts are estimated by % volume instead of % weight. NOTE
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 01598
Location - North: ______ East: ______
Date: 04/17/98
Geologist: Zane Tuta
Drilling Equip.: geoprobe - continuous

Surface Elevation: ______
Area: 903 Pad/Ryan's Pit Plume
Total Depth: 10.2
Company: IT Corp.
Project No.: ______
Sample Type: Continuous

EG&G LOGGING SUPERVISOR APPROVAL ______ DATE ______

0915

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0 to 8.4 ft	Run #1 2.0	1.5				~~ml~~	ml	0–1		0.0 - 1.2 SILTY CLAY, dk grayish brown (10YR 4/2), soft, moist, with trace sand. Rootlets.
							ml	1–3		1.2 - 3.0 SILTY CLAY, brown (10YR 5/3) mottled with yellowish brown (10YR 5/6), soft, moist, with some sand.
	Run #2 4.0	2.5					sm	3		3.0 - 3.5 SILTY SAND, brown (10YR 5/3) mottled with yellowish brown (10YR 5/6) soft, moist, fine, subround
	Run #3 6.0	2.4	008.022 (RS)				ml	4–7		3.5 - 7.0 SANDY SILT, grayish brown (10YR 5/2) mottled with brownish yellow (10YR 6/3) and abundant ~~grayish~~ white caliche (10YR 8/1), SLIGHTLY moist
	Run #4 8.0	2.5	6.0 – 6.6 – 7.0					7		TOP OF WEATHERED BEDROCK 7.0
Box 2 of 2 8.4 to 10.2 ft 8.4 ~~10.2~~	Run #5	2.3	RIN 98A1600 008.023 (VR)					7–10		7.0 - 10.2 CLAYEY SILTSTONE, dark grayish brown (10YR 4/2), mottled w/ yellowish brown (10YR 5/6), orange limonitic stain coating fractures. Limonitic Fossil leaf fragment at 9.5. Highly weathered, near horiz. bedding laminae faintly visible. SLIGHTLY moist.

0934

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

400397

(4011-930-0134-930) Form GT.1A (03/01/92)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 01598
Location - North: — East:
Date: 04/17/98
Geologist: ZANE TUTA
Drilling Equip.: geoprobe - continuous
Surface Elevation:
Area: 903 P.D/Ryan's P.T Plume
Total Depth: 10.2
Company: IT corp. Project No.:
Sample Type: continuous

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
0945 -	10.2									
	TD									

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 01698
Location - North: East:
Date: 4/21/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe
Surface Elevation:
Area: 903 PAD RYAN'S PIT PLUME.
Total Depth: 16.2
Company: "
Project No.:
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL
DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0.0-9.0	Run #1	1.2						0–1		0.0-0.5 - SILTY CLAY LOAM v. dk. br. (10YR 2/2) w/gravel and abundant root hairs. s. moist. 0.5-1.2 - SILTY CLAY, dk. yellowish br. (10YR 4/4) some root hairs.
	2.0	60%						2		2.0-3.0 SILTY CLAY w/SAND, light yellowish br. (2.5Y 6/4) w/ v. f. gr. sand. DAMP. w/caliche
	#2	2.1						3		3.0-4.0 SILTY CLAY, l. yellowish br. (2.5Y 6/4) sand decreasing to none. w/caliche. DAMP.
	4.0	105%						4		4.0-6.0 CLAYEY SAND TO SANDY CLAY l. yellowish br. (2.5Y 6/4). v. f. gr. sand, some caliche, DRY.
	#3	2.1						5		
	6.0	105%						6		6.0-8.0 ~~sand~~ DRY
	#4	2.1						7		
	8.0	105%						8		8.0-10.0 becoming SILTY SAND w/ clay l. yellowish br. (2.5Y 6/4) DAMP
9.0 Box 2 of 2	#5	2.2						9		
	10.0	110%						10		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

400399 (4011-930-0134-930) Form GT.1A(03/01/92)

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 01648
Location - North: ______ East: ______
Date: 4/21/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation: ______
Area: 903 PAD RYAN'S PIT PLUME
Total Depth: 16.2
Company: IT
Project No.: ______
Sample Type: continuous

EG&G LOGGING SUPERVISOR APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 9.0 - 16.2	#6	2.2 / 110%	RS 009-025; VCC 009-024					10–12		10-12 SILTY SAND~~STONE~~, light yellowish brown (2.5Y 6/2), well sorted some bedding planes, v.f.gr. sand clay content clay content ↑ from 11.4 – 11.8 DAMP ~~DRY~~
								12–13		12-13 same DAMP
	#7	2.4 / 120%						13–14		13-13.6 SILTY SAND~~STONE~~ w/CLAY light yellowish brown (2.5Y 6/2) DAMP 13.6-14. SAME CLAY CONTENT ↑ DAMP. w/some iron ~~st~~aining 14.0-14.9 same TOP OF W. BR.
16.2	#8	2.5 / 125%	14.7–15.5					14–16		14.9-16.2 SILTY CLAYSTONE light olive br. (2.5Y 5/4) w/ sand, v.f.gr. ~~bedding~~ planes w/ iron staining and concretions, w/ quartz pebble, coarse at 14.9 DRY
TD			SAMPLE RING 98A1600							16.2 TD

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

403400

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 01798
Location - North: East:
Date: 4/21/98
Geologist: [illegible]
Drilling Equip.: geoprobe

Surface Elevation:
Area: 903 PAD / Ryan's Pit Home
Total Depth: 8.0
Company: IT
Project No.:
Sample Type: continuous

EG&G LOGGING SUPERVISOR APPROVAL

DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
	Run #1	1.2	010-030 ISO					0		0.0-0.4 SILTY CLAY LOAM, v. dk. br (10YR 2/2) w/gravel (coarse pebbles) and abundant root hairs, v. moist. 0.4-1.2 SILTY CLAY, yellowish br (10YR 5/6) w/ fine to coarse pebbles subround mafic, w/caliche, moist
	2.0	60%						1		
	#2	1.7	010-020 25 / 010-029 VOC					2		2.0-2.4 - same sl. moist some v.f. gr. sand. 2.4-3.7 - same dk. yellowish br. (10YR 4/4) some caliche, sl. moist.
	4.0	85%						3		
	#3	2.0	4.3 / 5.2					4		4.0-5.0 - SILTY CLAY, dk yellowish br. (10YR 4/4) some v.f. gr. sand some caliche moist.
	6.0	100%						5		TOP of W.Bd SILTY CLAYSTONE 5.0 Grayish br (2.5Y 5/2) to olive br. (2.5Y 5/4) moist. soft. no coarse. some iron staining.
	#4		SAMPLE RIN #98A1600					6		6.0-8.0 same v. sl. moist.
	8.0							7, 8		

TD = 8.0

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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404/401

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 01898
Location - North: East:
Date: 4/22/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation:
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 8.2
Company: IT Project No.:
Sample Type: Continuous

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
								0		0.0-0.3 - ~~VOC~~ SILTY CLAY, v. dk. grayish br. (10 YR 3/2) abundant root hairs coarse mafic pebbles subrounded V. MOIST.
	Run # 1	0.5	011-031 VOC DUP					1		0.3-0.5 - SILTY CLAY, yellowish br. (10 YR 5/6) to light brownish gray (10 YR 6/2) mottled, w/caliche, some roots hairs weathered MOIST.
		25%						2		2.0-3.2 SILTY CLAY, olive ~~brown~~ (5Y 4/4) (2.5Y 4/4) some f. gr. sand, abundant caliche very weathered MOIST TO SL. MOIST mottled
	# 2	2.4						3		3.2 4.0 TOP OF WEATHERED BEDROCK SILTY CLAYSTONE, light olive brown (2.5 Y 5/6) w caliche in layers and in nodules, iron nodules, MOIST. MASSIVE
		120%	3.4–4.5					4		4.0-4.3 - SILTY CLAYSTONE, olive gray (5Y 4/2) w/caliche as crystals and in veins. MOIST AT 4.0 V. SL. MOIST AT 4.3. BLOCKY.
	# 3	2.1	001-001 RS 001-002 VOC					5		4.3-~~6.0~~ 5.9 SILTY CLAYSTONE, dk grayish br., (2.5 Y 4/2) w/ iron staining, minor caliche, V. sl. moist.
		105%						6		5.9-6.0 - SILTY CLAYSTONE, dk. grayish br. (2.5 Y 4/2) BLOCKY, V. DRY.
	Run # 4	2.2	SAMPLE					7		~~5.8~~ 6.0-8.2 - same
	8.2	100%	RIN 98A1806					8		
										8.2 = TD

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 01948
Location - North: East:
Date: 4/23/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation:
Area: 903 PAD RYANS PIT PLUME
Total Depth: 8
Company: IT
Project No.:
Sample Type: Continuous

EG&G LOGGING SUPERVISOR APPROVAL

DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
	Run #1	1.0								0.0-0.7 - SILTY CLAY LOAM, dk br. (7.5 YR 3/2) occasional f to M ~~gravel~~ pebbles, Subang/Subround abundant roots. V. moist.
										0.7-1.0 - SILTY CLAY, yellowish br. (10YR 5/8) occasional f. pebble subrounded, occas. roots. MOIST
	2.0	50%	2.0					2		2.0-2.4 - SILTY CLAY, dk yellowish br (10YR 4/6) some root hairs, minor v.f. pebbles to v. coarse sand well rounded. Hol
			2.7							2.4-3.7 TOP WEATHERED BR.
	#2	1.7								CLAYSTONE, light ol. br. (2.5Y 5/4) occass. caliche nodules, limonitic staining, mottled massive sl moist.
	4.0	85%	SAMPLE RIN# 98A1806 003-007 RS 003-008 VOC					4		4.0-4.4 CLAYSTONE AS ABOVE. V. SL. MOIST.
	#3	2.5								4.4-6.0 - CLAYSTONE - grayish br. (2.5Y 5/2). DRY TO V. DRY, DRIER W/DEPTH - BLOCKY.
	6.0	85%						6		6-8.0 Same. V. DRY.
	#	2.3						7		
	8.0							8		
										TD = 8

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Materials amounts are estimated by % volume instead of % weight.
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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 02C95	Surface Elevation:
Location - North: East:	Area: 903 PAD/RYAN'S PIT PLUME
Date: 4/22/95	Total Depth: 6.1
Geologist: Jim Cox	Company: IT Project No.:
Drilling Equip.: Geoprobe	Sample Type: Continuous.

EG&G LOGGING SUPERVISOR

APPROVAL ______________________ DATE ______________________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
	Run #1	1.7						1		0.0-0.5 - SILTY CLAY, v. dk br. (10YR 2/2), abundant roots, moist. soil horizon. 0.5-1.7 - SILTY CLAY, brown, (10YR 5/4) w/sand f.gr. w/some pebbles, fine to med. subang/subround, one v. coarse pebble subround, occass. caliche nodules, sl. moist.
	2.0	85%						2		2.0-3.0 - SILTY CLAY br. (10YR5/4) w/f. gr. sand occas. caliche as nodules, massive, sl. moist.
	#2	1.6						3		TOP OF WEATHERED BR. 3.0-3.6 - SILTY CLAYSTONE light olive br (2.5Y 5/4) occas. caliche nodule, limonitic staining mottled, massive, sl. moist.
	4.0	80%						4		4.0-4.3 same.
	#3	3.0						5		4.3-6.1 - SILTY CLAYSTONE TO CLAYSTONE grayish br. (10YR5/2) occassional iron concretion, minor limonitic staining blocky, becoming drier w/depth 4.3 v. sl. moist to at 4.9-6.1 v. DRY.
	6.1	150%						6		

TD = 6.1

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

4014/04

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 52198
Location - North: East:
Date: 4/13/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation:
Area: 903 PAD/RYAN'S PIT PLUME
Total Depth: 12.0
Company: IT CORP
Project No.:
Sample Type: continuous

EG&G LOGGING SUPERVISOR APPROVAL

DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2								0		0.0-0.7 SILTY CLAY, dk yellowish br. (10YR 3/4) w/roothairs, some fine pebbles from 0.0-0.2. MOIST.
	Run #1	1.6						1		0.7-1.6 - SILTY CLAY, ~~dk yellowish br.~~ ~~some roothairs~~ to grayish br. (2.5Y 5/2) mottled, limonitic staining w/caliche both in nodules & layers. soft, moist.
	2.0	80%						2		2.0-3.2 - SILTY CLAY, dk. grayish br. (2.5Y 4/2) to dk yellowish br. (10YR 4/3) w/caliche w/roothairs - no observed pebbles. Soft. MOIST.
	#2	2.2	RIN#98A1600					3		3.2-4.0 SILTY CLAY, dk gray (10YR 4/1) becoming dryer still sl. moist, less soft. Transition to
	4.0	110%	4.3					4		4.0-4.5 as above SILTY CLAY w/some blocky clay clasts. v. sl. moist.
			4.9							4.5 well developed caliche layer. TOP W. BR
	#3	1.9	007-019 VOC / 007-020 VOC					5		4.5 - ~~6.0~~ SILTY CLAYSTONE, yellowish br. (10YR 5/4) w/abundant caliche. V. HARD, V. DRY. caliche nodule at 5.9.
	6.0	95%						6		6.0-8.0 SILTY CLAYSTONE, dk. grayish br (2.5Y 4/2), mottled, limonitic staining some caliche (abundant at 7.3) DRY, MASSIVE
	#4	2.1						7		
	8.0	105%						8		8.0-10.0 same w/ iron staining (abundant at 8.9. DRY. / PLASTIC. MASSIVE.
9.5	#5	2.1						9		
Box 2 of 2	10.0							10		

Right margin: Mois / Mois / 3.9 / 4.5 SI MO / 4.6 0

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core. accurate footage measurements not possible.
(2) Core breaks cannot be matched. accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 02148
Location - North: East:
Date: 4/13/98
Geologist: Jim Cox
Drilling Equip.: Geoprobe
Surface Elevation:
Area: 903 PAD RYAN'S PIT PLUME
Total Depth: 12.0
Company: IT
Project No.:
Sample Type: continuous

EG&G LOGGING SUPERVISOR APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2	#6	2.5								10.0-12.0 CLAYSTONE, olive brown (2.5Y 4/4) HARD, DRY w/ IRON STAINING, ABUNDANT IRON STAINING FROM 11.0-12.0 CONCRETION AT 11.5.
12.0								12		
TD = 12.0										TD = 12.0 Refusal
										Backfill to 8.0 w/Bent.

NOTES. General: USCS is modified for this log as follows:
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(1) Badly broken core, accurate footage measurements not possible.
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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 1

Borehole Number: 02298
Location - North: East:
Date: 4/10/92
Geologist: Jim Cox
Drilling Equip.: Geoprobe

Surface Elevation:
Area: 903 PAD/RYAN'S PIT PLUME.
Total Depth: 8.3
Company: IT CORP Project No.:
Sample Type: continuous

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 1	(run #1)	2.0	006-016 Rad Scr 017 VOL.							0.0-0.7 V. CLAY LOAM, v. dk. gr. br. (10YR 3/2) w/root hairs, some fine pebbles subang/subround, moist, v. soft.
								1		0.7-2.0 - SILTY CLAY, dk yellowish br (10YR 4/4) w/some iron staining, occassional roothair, w/rare f. pebble. moist, soft.
	2.0	100%						2		2.0-4.0 - SILTY CLAY, dk. gr. br (2.5Y 4/2) occassional fine pebble, subang/subround. some caliche, some iron staining. sl. moist, sl. soft.
	#2	2.0	8.3					3		
	4.0	100%	SAMPLE 4.2					4		4.0-4.6 same, drier/harder.
	#3	2.0	RIN # 9BA1600					5		4.6 Top weathered BR. 4.6-6.0 SILTY CLAYSTONE, dk. gr. br (2.5Y 4/2) w/limonitic staining (some). w/caliche, no pebbles, DRY, HARD.
	6.0	100%						6		6.0-7.8 CLAYSTONE, dk, gr. br (2.5Y 4/2) w/clasts and sheer planes w/slickensides iron concretion at 6.8. BLOCKY, DRY HARD
	#4							7		7.8-8.0 CLAYSTONE, dk, gr. br (2.5Y 4/2) mottled, limonitic staining w/sheer planes w/slickensides MASSIVE, DRY
8.3	8.0							8		
	TD ~~8.0~~ 8.3									TD = 8.3 REFUSAL.
	~~#5~~							~~9~~		
	~~10.0~~							~~10~~		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

(4011-930-0134-930)(Form GT.1A)(03/01/92)

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 03198
Location - North: ______ East: ______
Date: 2/12/98, 6-2-98
Geologist: T. Lorseth (Rig) F. Grigsby (Log)
Drilling Equip.: Stratoprobe

Surface Elevation: ______
Area: SE of Solar Ponds
Total Depth: 12.0'
Company: Tierra
Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2	Run No 1 0-4'	Rec 3.7'				FG / FG	CL / SM / ~~GM~~ SC / CL	0, 1, 2, 3		0-0.5 Gravely Clay - some silt & sand - Dusky Brown (5YR 2/2). Sl. Damp. Gravel quartzite - some feldspar - broken fragments - Low plasticity. Top Soil. Some root fragments. 0.5-1.3' Clayey ~~sandy~~ gravel, some sand & silt. Matrix Dark yellowish brown (10YR 4/2) Gravel med well graded - Pred. Quartzite - Int. ~~damp~~ damp. wx. 1.3'-3.7' Sandy Clay - (10YR 4/2) Dark yellowish Brown Damp - estimated med plasticity. Sd. fine grained - poorly graded. - Int. appears non-permeable - ~~Int FG~~. 3.7'-4.0' No Recovery
Box 1 of 2	Run No. 2 4.0'-8.0'	Rec 4.0'					GC / GM / GC	4, 5, 6, 7, 8		4.0'-4.4 - Clayey Gravel - Matrix - Dark yellowish Brown (10YR 4/2) large fragments of feldspar and quartzite ~~at~~ at top of interval Core damp. 4.4 ~~Dr~~ 5.2' - Sandy Gravel - some clay - Matrix Pale yellowish brown (10YR 6/2) to very Pale Orange (10YR 8/2) Overall interval appears very Permeable. (Still in lexon sleeve.) Core damp. 5.2 - 6.7' Clayey gravel - Matrix Pale yellowish brown (10YR 6/2) - Gravel Pred. quartzite Well graded, subangular - Sl. Damp.
Box 2 of 2	Run No. 3 8.0'-12.0'	Rec. 4'						9, 10		6.7-12.0' TOP of Bedrock - Claystone - Dark yellowish

NOTES: General: USCS is modified for this log as follows: Core Stored in lexon sleeves - Moisture retained.
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

4H408 4011-930-0134-930(Form GT.1A)(03/01/92)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 03198
Location - North: East:
Date: 2/12/98 & 6/12/98
Geologist: Tilouseth (Rig) F. Grigsby (Log)
Drilling Equip.: Strataprobe
Surface Elevation:
Area: S.E. of Solar Ponds
Total Depth: 12'
Company: Tierra
Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ____ DATE ____

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2	Run No. 3 8.0'-12.0'	Rec. 4.0'						10		6.1-12.0 - Continued Brown (10YR-4/2) grading To Brownish Gray (5YR 4/1) Core Varies from Sl. Plastic (upper part - Sl. damp) to dry & indurated. Some reworked section below Contact. Note: Top 0.4' of Core from Run No. 3 is sluff from above -
								11		
								12	TD	

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 03298
Location - North: ________ East: ________
Date: 02/12/98 & 6-3-98
Geologist: T. Lovseth (Rig) F. Grigsby (Log)
Drilling Equip.: Stratoprobe

Surface Elevation: ________
Area: E.S.E. of Solar Ponds
Total Depth: 25'
Company: Tierra
Project No.: ________
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ________ DATE ________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG
Box 1 of 3	Run No 1 0'-4'	Rec 3.3'		45° 60°			SM, Cl, CL, CL, GC	0–10	Shear zone
	Run No. 2 4'-8'	Rec 3.8'							
	Run No 3 8'-12'	Rec 4.0'							

SAMPLE DESCRIPTION

0-0.6' Gravely Silt - some Clay & sd. - Grayish Brown (5YR-3/2) - Estimated low Plasticity. - Core dry - Roots & Plant debris. - Topsoil zone.

0.6'-1.5' - Silty Clay - Some Sd. - Tr. gravel. Pale Yellowish Brown (10YR 6/2) with Grayish Brown (5YR 3/2) inclusions. - Med Plasticity (estimated) - Sl. damp - Sl. plastic. Wx. -

1.5'-1.6' - broken cobble.

1.6'-1.8' - Silty Clay - same as 0.6-1.5 (Based on small sample).

1.8-2.8' - Sandy Clay - some silt Tr. gravel - Pale Yellowish Brown (10YR 6/2) to Grayish Orange (10YR 7/4) (Fe stained) - Estimated Med. Plasticity, - Non-Permeable, - Wx I stained. Core Sl. damp.

2.8-3.3 - Shear Zone - Top 0.2' of interval is Pale Yellowish Brown (10YR 6/2) Yellowish Orange (10YR 7/4) with Grayish Fe staining ~~against~~ Fe. Silty Clay against Dark Redish Brown (10R 3/4) Sandy Clay - ∠ - Approx. 45° Lower Shear is a moderate Brown (5YR 3/4) Silty Clay against a Clayey gravel - (Matrix Pale Yellowish Brown (10YR 6/2) - ∠ ≅ 60° White Coating over lower interval

3.3-8.3 see next Page

NOTES: General: USCS is modified for this log as follows: Core stored in lexon tubes - retained some moisture.
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

48410

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 03298
Location - North: East:
Date: 2/13/98 & 6/3/98
Geologist: T. Lovsetth (Rig) F. Grigsby (Log)
Drilling Equip.: Stratoprobe

Surface Elevation:
Area: E.S.E. of Solar Ponds
Total Depth: 25'
Company: Tierra (DSI) Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box No 2 of 3	Run No. 3 8.0'-12.0'	Rec: 4.0'						10 – 12		3.3'-6.3 Clayey gravel - Some silt - Moderate Brown (5YR 3/4) at Top of interval - grading to Pale Yellowish Brown (10YR 6/2) at bottom of interval. - Core dry - clay mod. indurated. - Some gravel are broken Cobbles - Minimum to non permeable because of clay matrix. Top 0.5 of core was compacted slough from above.
	Run No. 4 12.0'-16.0'	Rec: 4.0'						12 – 16		6.3-7.8': Sandy Clay - Some silt, Gravel and Caliche in upper 0.3' of interval. - intermixed Brownish gray (5YR 4/1) and Yellowish gray (5Y 8/1) Clays, Caliche & Caliche nodules at 6-8', and Caliche rich interval from 7.2 to 7.5'. Sand fine to med., Quartz, Quartzite & some mafics. - Interval mod. indurated, sl. damp. - est. estimated mod. plasticity. 7.8'-8.0' - No Recovery. 8.0-17.8 - Top of Bedrock
	Run No. 5 16.0'-19.0'	Rec: 4.0'						16 – 19		Claystone. Pale yellowish Brown (10YR 6/2) at top of interval, grading to Brownish Gray (5YR 4/1) below 16' to 17.8' - Upper part of core highly reworked - Some Caliche nodules in upper two feet. All runs, are ~~packed~~ re packed causing induced horizontal fractures along bedding or Parting Planes. - occasional 45° fractures related to coring.
Box 3 of 3								19 – 20		Core Sl. Damp, moderately indurated, some zones of Grayish Orange (10YR 7/4) Fe staining.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 3 OF 3

Borehole Number: 03298
Location - North: ______ East: ______
Date: 2/13/98 & 6/3/98
Geologist: T. Lovseth (Rig) F. Grigsby (Log)
Drilling Equip.: Strataprobe
Surface Elevation: ______
Area: E.S.E. of Solar Pond
Total Depth: 25'
Company: Tierra (DGI) Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box No. 3 of 3	Run No. 6 19' - 23'	Rec. 4.0'						20 – 23		17.8 - 25' - Clayey Siltstone - Grayish orange (10YR 7/4) - From 17.8 to 19', Core grades from Claystone to ~~Silts~~ - Clayey Siltstone. Below 19.0' recovery was poor on the initial run, and recovered wet slough. Pieces of larger diameter core recovered during clean out indicate the bottom of the hole is clayey siltstone.
	Run No 7 23.0' - 25.0'	slough to 23.5' Rec. 4.0'						23 – 25		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

45/12

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 03398
Location - North: ______ East: ______
Date: 3/17/98 & 6/4/98
Geologist: T. Lovseth (Rig) F. Grigsby (Log)
Drilling Equip.: Stratoprobe
Surface Elevation: ______
Area: W. of STP
Total Depth: 19.0'
Company: Tierra (DGI) Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3 0'-9.5'	Run No. 1 0'-4.0'	Rec: 4.0'					CL	0–4		0-4.0' - Gravelly Clay - Some Silt & Sd. - Fill Material - Moderate Yellowish Brown (10YR 5/4) To Dark Yellowish Brown (10YR 4/2) varies from very silty to very clayey - Amount of gravel varies throughout interval - generally abundant this interval. Core damp -
	Run No. 2 4.0'-8.0'	Rec: 4.0'					CL	4–8		4.0'-8.6' Silty Clay - some gravel - Same as above except less gravel. - Plasticity in both intervals generally med. to high. Core Damp. - Pliable. Fill Material. 8.6 - 9.6' Silty Clay - Some sd. - Tr. gravel (small) - Dusky Yellowish Brown (10YR 2/2) soil Horizon before fill. - Core Sl. damp. - Estimated med. Plasticity - Some Carbonaceous material.
	Run No. 3 8.0'-11.0'	Rec: 3.5'					CL	8–10		9.6'-13.7' Silty Clay - some sd - Tr. gravel. Same as above except Color ranges from Moderate Yellowish Brown (10YR 5/4) to Dark Yellowish brown (10YR 4/2) Estimated Med. Plasticity. - Core sl. damp - Pliable - Occassional med. size Pebble imbedded in Core (Contact not Pushed down)

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

413
416

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 03398
Location - North: ______ East: ______
Date: 2/17/98 & 6/4/98
Geologist: T. Leveseth (Rig) F. Grigsby (Log)
Drilling Equip.: Strataprobe
Surface Elevation: ______
Area: W. of STP
Total Depth: 19.0'
Company: Tierra (DGI) Project No.: ______
Sample Type: Continuous Core.

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box No. 2 of 3 9.5'-16.5'	Run No. 3 8.0'-11.0'	Rec: 3.5'						10–11		13.7'-15.1': ~~Sand~~ F6. Silty Clay~~stone~~ with interbedded Clayey Sand~~stone~~ Fe Clay~~stone~~ Fe Pred. Pale yellowish brown (10YR 6/2), (~~Sandstone~~ + sandy intervals) Grayish orange (10YR 7/4) Top of interval grades from Pred. Clay~~stn~~ Fe to Clayey Silt~~stn~~ Fe sandy intervals comprised of VF6 to F6 well sorted ~~Quartzitic~~ grains, Range from Subrd. to Spherical - Possible reworked #1 Sandstn - Entire interval Comp to friable. moist - weathered.
	Run No. 4 11.0'-14.0'	Rec: ~~4.0~~ 3.5'					CL	11–14		
	Run No. 5 14.0'-16.5'	Rec: 4.0'					CL.	14–16.5		15.1-16.5' - Claystn. Top of Bedrock. Composed of intermixed zones of Pale yellowish brown (10YR 6/2) and Pale Brown (5YR 5/2) and ~~and~~ Fe or Claystone lens - Dark Carbonaceous beds - Dark material associated with the pale brown intervals. Dark yellowish orange (10YR 6/6) ~~occurs as~~ Fe. Fe staining and coating occurs as coating on clay oct or as filling in several micro fractures.
Box 3 of 3 16.5'-19.0'	Run No. 6 16.5'-19.0'	Rec: 4.0'						16.5–19	TD	16.5'-19.0' - Claystone - Some Interbedded Sandstones. Claystn. Pale Yellowish Brown (10YR 6/2) Sdstn. Dark Yellowish Orange - (10YR 6/6) Core highly over-compressed. 2 ft. of Slough (Prod. Sd.) at Top. No accurate depths Possible. Core damp. highly compressed

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 03498
Location - North: ______ East: ______
Date: 2-17-98 & 6-5-98
Geologist: T. Lovasetto (Rig) & Grigsby (log)
Drilling Equip.: Stratoprobe

Surface Elevation: ______
Area: Solar Pond Plume
Total Depth: 16'
Company: Terra (DOE) Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______________ DATE ______________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3	Run No. 1 0-4'	Rec: 2 1/2'					CL	0		0-0.4 Silty Clay - Tr. Sd. Topsoil Dusky Brown (5YR 2/2). Sl. Damp - friable - abundant Roots -
							CL	1		0.4-1.4': Clay - some sd & Gravel in bottom 0.4 ft. of interval. - Moderate Yellowish Brown (10YR 5/4) to dark Yellowish Brown (10YR 4/2) with some Grayish Orange (10YR 7/4) Mottling. Quartzite gravel to ± 3/4" in lower 0.4' of interval. Core Slightly damp - estimated med-high Plasticity - Contains roots.
							GC	2		1.4'-2.5': Clayey Gravel. matrix Moderate Brown (5YR 4/4) grading to Grayish Orange (10YR 7/4) at bottom of interval. - Gravel well graded from Cobble size to f G. - Pred quartzite - sub angular - clay matrix - est. med plasticity. Int. Wx - Core Sl. Damp - Covered with residual white rock dust (?)
								3		2.5'-4.0': No Recovery.
	Run No. 2 4.0'-7.5'	Rec: 4.0'					CL	4		4.0'-5.7': Clay - ~~Some Gravel~~ - Pred. Moderate Yellowish Brown (10YR 5/4.) Sl. Damp - friable, ~~estimated~~ estimated med to med. high plasticity. Scattered large gravel - Int. Wx.
								5		
								6		
								7		
Box 2 of 3	Run No. 3 7.5'-10'	Rec: 4.0'					CL	8		~~5.7-10.3~~ 5.7'-11.6': Silty Clay - Some gravel - old soil horizon. - ~~Abunda~~ Dusky Brown (5YR 2/2) in top
								9		
								10		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

98 4/15

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 63498
Location - North: ________ East: ________
Date: 2-18-98 & 6-5-98
Geologist: T. Lavgetti (Rig), E. Grigsby (Log)
Drilling Equip.: Stratoprobe

Surface Elevation: ________
Area: Solar Pond Plume
Total Depth: 16'
Company: Tierra (DGI) Project No.: ________
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ________________ DATE ________________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG
Box 2 of 3	Run No. 4 10.0'-12.0'	Rec: 2.0'					CL	10–11	
	Run No. 5 12.0'-14.0'	Rec: 3.0'					GC	11–13.3	
Box 3 of 3	Run No. 6 14.0'-16.0'	Rec 2.5'		60°				13.3–16	
								16	TD

SAMPLE DESCRIPTION

5.7-11.0' (Continued) half of interval - To olive gray (5Y 4/1) in lower half of interval. Core damp - med to med high plasticity. gravel & Carbonaceous material in top half. - Plant imprints & roots at approx. 6.7'. Core become homogeneous below 8.2' ± (where color change occurs). - 45° fracture at 6.7' - may be induced.

Color Change to Grayish Orange (10YR 7/4) occurs from 10.0'-10.3'. May be related to slough at top of run. - Scattered gravel from 10.2'-11.0'

11.0'-13.3' - Clayey Gravel - Matrix Pale yellowish Brown (10YR 6/2) - Gravel pred. quartzite - well graded from broken cobbles to small. - Approx. 1.0' of slough & clay from above in run from 12.0'-14.0' - Core dry

13.3'-16.0' - Top of Bedrock. Claystone. - Dusky Brown (5YR 2/2) in upper half of interval grading to Pale yellowish Brown (10YR 6/2) with abundant Grayish orange (10YR 7/4) Limonitic stained fracture filled zones in lower half of interval. Entire interval appears reworked and/or brecciated. Induced horizontal fracture prevalent throughout interval. One large healed fracture (60°?) from approx. 14.3'-14.8' (Fe Stained). Other random healed fractures below this interval.

Some disseminated Calcite occurring in top 0.2'-0.3' of interval. Core dry.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

416

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 10098
Location - North: East:
Date: 7/30/98 - 7/31/98
Geologist: J. BOYLAN, T. LUTHERER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: BLDG. 123
Total Depth: 11.0
Company: TIERRA Project No.:
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOG. LOG	SAMPLE DESCRIPTION
0.0	0.0 RUN 1: 0.0-4.0	0.0 1.2					SM	0.0 – 1.2		Gravelly, silty sand w/clay – dominantly dark brown (10YR 3/3). Sl. moist to moist. NOTE: Entire interval probed first w/solid point; recovered core is disturbed "cleaning run."
								1.2 – 4.0		NO RECOVERY 1.2-4.0
	4.0 / 4.0 RUN 2: 4.0-5.5	4.0 / 4.0 ~~3.1~~ 2.1						4.0 – 5.5		Same as above 0.0-1.2'. Colors more variable, mottled. Caliche-rich zone near base (~5.1-5.3'). Sl. moist to moist. Caliche zone is clayey, pliable. NOTE: coring run followed pre-probe w/solid point.
	5.5 / 5.5 RUN 3: 5.5-8.0	5.5 / 5.5 3.3						5.5 – 7.0		Same as above ~~5.5~~ 0.0-1.2'. Gradual lower contact. Dominant color about brownish yellow (10YR 6/6) to light yellowish brown (10YR 6/4) – very mottled. Clay pods common. Coarser toward base. See NOTE below!
	~~8.0~~ RUN 4 8.0 – 9.0	~~6.0~~ ~~2.5~~ 8.0 0.5					GM	7.0 – 8.5		Sandy gravel w/silt, clay – same as above, 5.5-7.0 but abundant shattered quartzite gravels. Moist. See NOTE below! SANDY GRAVEL WITH SILT/CLAY – SAME AS ABOVE, ABUNDANT SHATTERED LITHIC GRAVELS, SATURATED.
								8.5 – 9.0		NO CORE TAKEN, 8.5-9.0
11.0	9.0 / 9.0 RUN 5: 9.0-11.0	9.0 / 9.0 0.0 (pre-probe)						9.0 – 10.0		NO RECOVERY – SOLID POINT 9.0-11.0

BOX 1 OF 1: 0.0 – 11.0'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

NOTE: ALL CORING RUNS ARE PRECEDED BY A SOLID-POINT RUN, SO depths, textures, etc have been disturbed.

417
~~400~~

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 10098
Location - North: East:
Date: 7-31-98
Geologist: J BOYLAN TAL / T. LUTHERER
Drilling Equip.: GEOPROBE

Surface Elevation:
Area: BLDG. 123
Total Depth: 11'
Company: TIERRA Project No.:
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
see previous page								10.0		NO CORE TAKEN
11.0	11.0	11.0						11.0		11.0' TD WITH PROBE TD = 11.0'
								12.0		
								13.0		
								14.0		
								15.0		
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

418

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10198
Location - North: East:
Date: 8/10/98
Geologist: J BOYLAN
Drilling Equip.: GEOPROBE
Surface Elevation:
Area: BLDG. 123
Total Depth: 13.3
Company: TIERRA Project No.:
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0						0.0		Asphalt
BOX 1 OF 2: 0.0-7.9	RUN 1: 0.0-4.0	3.4					GM/GC	0.6		Silty gravel-sand mixture ranging to clayey, silty gravel-sand mixture - dark brown (7.5YR 4/3) below 0.9 very dark grayish brown (2.5Y 3/2) above. Sl. moist. Gravel: mostly shattered, quartzite.
							CL	2.4		Silty clay - red (2.5YR 4/6) to dark red (2.5YR 3/6). Moist. Contains rotting SS clasts or sand rip-up clasts that are very pale brown (10YR 8/4). Fairly sharp upper & lower contacts.
							GM	3.1		Silty, sandy gravel to silty gravel-sand mixture - mottled, but predominantly various shades of brown. Shattered quartzite common. Slightly moist to moist.
								3.4		NO RECOVERY 3.4-4.0
	4.0 / 4.0	4.0 / 4.0						4.0		Same as above, 3.1-3.4'.
	RUN 2: 4.0-6.5	3.3, incl. 0.8' slough								
	6.5 / 6.5	6.5 / 6.5						6.5		Same as above, 3.1-6.5'
7.9 / 7.9	RUN 3: 6.5-9.8	4.0, incl. 0.7' slough								
↓	9.8 see next page	9.8						9.5 / 10.0		Same as above 3.1-9.8' (Cont'd next page)

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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~~420~~

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10198
Surface Elevation:
Location - North: East:
Area: BLDG. 123
Date: 8/10/98
Total Depth: 13.3
Geologist: J. BOYLAN
Company: TIERRA
Project No.:
Drilling Equip.: GEOPROBE
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL
DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
	9.8 RUN 4: 9.8-13.2	9.8 4.0 incl. 0.6' slough	actually more slough than 0.6', as core barrel was very overpacked. JNB				GM	10.0 – 13.2		Core very overpacked - top portion is slough, but due to overpacking, distinction between "slough" and "core" is difficult.
13.3	13.2 RUN 5 13.3	13.2 0 13.3						13.2 – 13.3		NO RECOVERY 13.2-13.3 - TIP REFUSAL

Depth scale: 10.0, 11.0, 12.0, 13.0, 14.0, 15.0, 16.0, 17.0, 18.0, 19.0, 20.0

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 10298
Location - North: ______ East: ______
Date: 8/4/98 - 8/5/98
Geologist: J BOYLAN
Drilling Equip.: GEOPROBE

Surface Elevation: ______
Area: BLDG. 123
Total Depth: 16.0
Company: TIERRA Project No.: ______
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBERS	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0 BOX 1 OF 2 0.0-10.0	0.0 RUN 1: 0.0-5.0	0.0 3.3					SC	0.0 1.0 2.0 3.0 3.3		Clayey, gravelly sand - dominantly dark brown (7.5YR 4/4). Pockets of caliche (~½", soft) common. Sl. moist to moist. Gravels typically <1" but some shattered fragments present, especially below ~~3.0~~ 2.3' where rock flour is also common. Color below 2.0' mottled. Material below 2.5' less moist than above. Material below 2.5 approaches GC. NOTE: Coring run followed solid-point pre-probe run, so core is disturbed, depths very approximate
								4.0		NO RECOVERY 3.3-5.0'
	5.0 / 5.0 RUN 2: 5.0-8.0	5.0 / 5.0 3.2'					GC	5.0 6.0 7.0		clayey, sandy gravel - much like above (0.0-3.3, especially 2.5-3.3) but coarser. Some lenses more clay-rich. Mottled above ~5.8' (browns, grays); below matrix typically is light olive brown (2.5Y 5/3). Sl. moist to moist. Caliche pocket @ 6.6'. Gravels shattered. Rock flour common. NOTE: 5.0-6.0' interval disturbed by solid-point pre-probe run.
10.0	8.0 / 8.0 RUN 3: 8.0-11.0 ↓	8.0 / 8.0 4.0 incl. 1.0' slough ↓					GC/SC	8.0 9.0 10.0		Clayey, sandy gravel to clayey, gravelly sand - same as above, 5.0-8.0 but more fines. Color ~~above 10.0 is predominantly~~ is mottled throughout, w/variegated browns, red/orange brown, olive grays. Sl. moist to moist. NOTE: Coring run followed pre-probe run, so core is disturbed.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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124

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10298
Location - North: ______ East: ______
Date: 8/5/98
Geologist: J Boylan
Drilling Equip.: GEOPROBE

Surface Elevation: ______
Area: BLDG. 123
Total Depth: 16.0
Company: TIERRA Project No.: ______
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.0 Box 2 of 2: 10.0-16.0'	see previous page	see previous page					GC/SC	10.0		See previous page
	11.3 / 11.0	11.0 / 11.0						11.0		
	RUN 4: 11.0-14.0	3.6 incl. 0.4' slough						11.0–14.0		Same as above, 8.0-11.0. Difficult to differentiate slough. Slough and 11.3-11.8' interval are wet; balance sl. moist to moist. Some portions GC, but overall it's a mix, GC/SC. Gravels still dominantly quartzite, shattered.
	14.0 / 14.0	14.0 / 14.0					GC	14.0		
	RUN 5: 14.0-16.0	4.0, incl. 2.0' slough						14.0–16.0		Sandy clayey gravel — Same as above 11.0-14.0, but coarser — more gravels (shattered quartzite mainly, but also some fresh pink k-spars). Predominant color in the sandy clay matrix is pale yellow (2.5Y 7/3) to light gray (2.5Y7/2). Slough is moist to wet, core is sl. moist to moist. Measured TD = 15.8', so slight caving occurred.
16.0	16.0	16.0						16.0		TD = 16.0'
								17.0		
								18.0		
								19.0		
								20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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425

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10398
Location - North: ______ East: ______
Date: 8/11/98
Geologist: J. Barlan
Drilling Equip.: Geoprobe
Surface Elevation: ______
Area: B-123
Total Depth: 11.3
Company: Terra
Project No.: ______
Sample Type: Continuous core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0	0.0						0.0		ASPHALT
	RUN 1: 0.0-4.0	3.2					GC/CL	0.6		Clayey, sandy gravel w/silt — dark brown (10YR 3/...)
							CL	1.4		Gravelly, sandy clay w/silt — mottled & streaked but mainly yellowish red (5YR 4/6). Mottling is shades of ochre & v. dark brown & browns. Sl. moist. Gravels mostly <0.5" but some shattered fragments of larger clasts also present. Coarsens @ base.
								3.2		NO RECOVERY 3.2-4.0
	4.0 / RUN 2: ~~4.0~~ ~~4.6~~ ~~[illegible]~~ (JAB) 4.0-7.6	4.0 ~~1.2~~ (JAB) 4.0, incl. 0.4' slough		NOTE! Material below 4.0 is from offset location different from that supplying the 0.0-4.0 core.			~~GC/SC~~ (JAB) SM/GM	4.0 / ~~4.8~~ (JAB)		~~Same as above 1.4-3.2, but slightly coarser~~ (JAB) ~~to gravelly sand-clay mixture. Some to abundant~~ (JAB) ~~black flecks/grains = Fe/Mn oxides? To GC@base.~~ ~~(Short run due to tip refusal)~~ (JAB) Gravelly silty sand to silty sand-gravel mixture dominantly strong brown (7.5YR4/6). Shattered gravels (mostly quartzite, traces sandstone, Feldspar). Some to abundant Fe/Mn oxides (black grains & flecks) present @ 4.0-4.5 decreasing below this. Some clay throughout, and clayey gravel lens present below 7.1'. Some portions sandyer, some more gravel-rich. NOTE: Resistive material present in offset location (which produced all core below 4.0'), underlain by very soft/void space. Not present in original hole (which produced 0.0-4.0 core).
7.6 / 7.6	7.6 / 7.6							7.6		Same as above 4.0-7.6'. Abundant shattered gravels, especially below 9.5'. Clay-rich lenses, as at 8.2', contain light brownish gray (2.5Y6/2) clays, usually. These lenses (GC) are common but not dominant. Sl. moist to moist.
8.6 / 8.6 Box 2 of 2: 8.6-11.3'	RUN 3: 7.6-10.0	4.0, incl. 1.6' slough								
	10.0	10.0						10.0		

BOX 1 of 2: 0.0-8.6'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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424

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10398
Location - North: ________ East: ________
Date: ~~8/8/98~~ 8/11/98
Geologist: J. BOYLAN
Drilling Equip.: GEOPROBE
Surface Elevation: ________
Area: BLDG. 123
Total Depth: 11.3
Company: TIERRA
Project No.: ________
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ________ DATE ________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
8.6 Box 2 of 2: 8.6 - 11.3 11.3	10.0 RUN 4: 10.0 - 11.3 11.3	10.0 2.6, incl. 1.3' slough 11.3					GC	10.0 11.0 11.3		Same as above, 4.0 - 10.0'. Sl. moist to moist. However, has graded to clayey gravel - clayey gravel-sand mixture. So, call it GC. change symbol to GC
								12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0		11.3' = T.D.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 10498
Location - North: ______ East: ______
Date: 8/7/98
Geologist: J BOYLAN
Drilling Equip.: GEOPROBE
Surface Elevation: ______
Area: BLDG. 123
Total Depth: 12.1
Company: TIERRA
Project No.: ______
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0 BOX 1 OF 1: 0.0 - 12.1	0.0 RUN 1: 0.0-4.0	0.0 2.2					SM	0.0 – 2.2		Silty, gravelly sand - Top 0.1' is very chippy, friable asphalt; bottom 0.1' of recovery is also asphalt. Balance is dry to sl. moist, dark yellowish brown (10YR 4/4), some clay, mostly fine gravels but a few >1".
								2.2 – 4.0		NO RECOVERY 2.2 - 4.0
	4.0 / 4.0 RUN 2: 4.0-8.0	4.0 / 4.0 1.2					SM/SC	4.0 – 5.2		Looks like artificial fill. Clean coarse sand @ 4.0-4.2', then sand-clay mixture w/ trace gravel to 4.6', then silty sand w/ trace clay (sand coarse) to 5.1, then sand-clay mixture to base of recovery (assumed 5.2, by convention). To fine gravel in top zone listed. Color predominantly the same as above.
								5.2 – 8.0		NO RECOVERY 5.2 - 8.0
12.1	8.0 / 8.0 RUN 3: 8.0-12.0	8.0 / 8.0 2.2					GM/GC	8.0 – 10.0		Sandy gravels w/ clay and silt - Mottled. Fresh, shattered & pulverized feldspar near base gives basal recovery a pink color, (7.5YR 5/6) w/ rest is overall strong brown same-colored and light gray (2.5Y 7/2) streamers of clay. Gravels fine to >1" (and therefore shattered), dominantly quartzite. Saturated to moist.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10498
Location - North: ______ East: ______
Date: 8/7/98
Geologist: J BOYLAN
Drilling Equip.: GEOPROBE

Surface Elevation: ______
Area: BLDG. 123
Total Depth: 12.1
Company: TIERRA Project No.: ______
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	see previous page	see previous page						10.0		See previous page
BOX 1 OF 1: 0.0-12.1'								10.2		NO RECOVERY 10.2-12.0'
								11.0		
~~12.0~~								12.0		NO RECOVERY 12.0-12.1 - TIP REFUSAL
12.1	12.1	12.1						12.1		TD = ~~12.0~~ JAB 12.1'
	RUN 4: 12.0-12.1	0.0						13.0		TD = 12.1'
								14.0		
								15.0		
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

14011-450-0134-430X Form GT.1A 40301/92

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10598
Location - North: ______ East: ______
Date: 8/6/98
Geologist: J BOYLAN
Drilling Equip.: GEOPROBE

Surface Elevation: ______
Area: BLDG. 123
Total Depth: 10.8
Company: TIERRA Project No.: ______
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0	0.0 RUN 1: 0.0-4.0	0.0 1.9					SM/GM	0.0 – 1.9		Silty gravel-sand mixture — Mottled, mainly very dark grayish brown (10YR 3/2) to dark brown (7.5YR 3/3). Moist (possibly due to recent rains and adjacent runoff route 2' to N of location 10598). Some portions SM, some GM; clayey zone @ base of recovery to GC. Gravels are shattered quartzite.
								1.9 – 4.0		NO RECOVERY
	4.0 / 4.0 RUN 2: 4.0-8.0	4.0 / 4.0 2.2					GM	4.0 – 6.2		Silty, sandy gravel w/ trace to some clay - mottled. Same dark brown (7.5YR 3/3) clayey material @ top of run as was present @ base of previous run; below this @ 4.6-5.0, is saturated gravel zone (dark brown, 10YR 4/3). Below 5.0 material is sl. moist to moist mottled w/ Fe oxides, color predominantly yellowish brown (10YR 5/8) to light yellowish brown (2.5Y 6/3 - this material is clayey). Mostly shattered quartzite gravels, some intact (<1").
								6.2 – 8.0		NO RECOVERY 6.2 - 8.0
BOX 1 OF 1: 0.0 - 10.8	8.0 / 8.0 RUN 3: 8.0-10.8	8.0 / 8.0 3.4 (1) see note at right						8.0 – 10.0		Same as above, 4.0-6.2'. Moist to saturated, many portions too muddy to determine features. Core liner stuck in barrel due to mud, and removed in sections, damaging core. (1) Some slough present at top, but muddy conditions prevent distinguishing it from actual core. Some zones to SM - nice sands w/ gravel.
10.8										

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 10598
Location - North: ______ East: ______
Date: 8/6/98
Geologist: J BOYLAN
Drilling Equip.: GEOPROBE
Surface Elevation: ______
Area: BLDG. 123
Total Depth: 10.8
Company: TIERRA   Project No.: ______
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______   DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
SEE PREVIOUS PAGE							GM	10.0		see previous page.
10.8	10.8 / 10.8	10.5 / 10.8						10.8		
								11.0		TD = 10.8'
								12.0		NOTE! Well installed in different hole, located 1.6 feet from the cored & described hole. Well TD (installed) is 8.22'.
								13.0		
								14.0		
								15.0		
								16.0		
								17.0		
								18.0		
								19.0		
								20.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20098
Location - North: ______ East: ______
Date: 6-24-98
Geologist: R. KOEHLER/F. Grigsby (Log)
Drilling Equip.: GEOPROBE/MACROCORE

Surface Elevation: ______
Area: NORTH - PA
Total Depth: 21.0'
Company: TIERRA
Project No.: ______
Sample Type: PUSH/CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box No. 1 of 3 0.85 - 9.2'	No Sample 0-0.85							0.0		0-0.85 - NO Sample Collected 0-0.6' - Asphalt. 0.6-0.85' - Road Base.
	Run No. 1 0.85 - 4.0'	Rec. 2.9'					CL	1.0		0.85 - 1.6' - Sandy Clay - Some Gravel - Sl. Damp. Est. Med. Plasticity. Light Brownish Gray (10YR - 6/2)
							CL	2.0		1.6' - 2.8' - Gravelly Clay. Some sand. Pale Olive gray (5Y - 5/3) - Sl. damp & pliable. Est. Med. high plasticity. Gravel, med size (Dominate) Quartzite & granitic clast. - Abundant black asphaltic material mixed with clay
							AC	3.0		
	Run No. 2 4.0' - 7.0'	Rec. 3.4' (0.4 asphalt)						4.0		2.8' - 3.6' - Sandy Clay - some silt - Tr. Gravel - Light Brown (5YR, 5/6) to Moderate Brown (5YR-4/4) Sl. damp - Sl. friable. Sd. poorly graded - fine-Med. gr. - WX
							CL	5.0		3.6 - 3.7' Clayey gravel - matrix Dusky Yellowish Brown (10YR - 2/2) One large quartzite clast that blocked core - 6. Shoe.
								6.0		3.7-4.0' - No Recovery 4.0' - 5.9' - Gravelly Clay - some sd. - Dark Yellowish Brown (10YR 4/2). Est. Med plasticity. - dense - Non friable Sl. damp - Gravel quartzite - some to 0.1' size.
	Run No. 3 7.0' - 10.0'	Rec. 3.6' (0.6 asphalt)					CL	7.0		5.9 - 7.3' - Silty Clay - some gravel. - Tr. sd. - Top 0.4' Dusky Yellowish Brown (10YR, 2/2). Lower interval more gravelly. Color change to Grayish Brown (5YR, 3/2) Est. Med Plasticity. ~~Darker 6 - Top~~ darker interval may be due to Contaminant Material.
							CL	8.0		
Box 2 of 3								9.0		7.3 - 8.0' - Gravelly Clay - Same as above (5.9 - 7.3') except slight increase in gravel content. 8.0' - 9.3' - Silty Clay - Some gravel - Color change to moderate yellowish
								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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-011-930-0134-930V Form GT.1A(03/01/92)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20098
Location - North: ________ East: ________
Date: 6-24-98
Geologist: F. Grigsby - Rigsby
Drilling Equip.: Geoprobe

Surface Elevation: ________
Area: North PA
Total Depth: 21.0'
Company: Terra Project No.: ________
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ________ DATE ________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 9.2'-15.4'	Run No. 4 10.0'-12.0'	Rec 3.1' (1.1 s/...)					CL	10–12		8.0-9.3 (Continued) Brown (10YR-5/4) Sl. Damp - non friable. Est. med plasticity. 9.3-13.3' Silty Clay - Trace of Gravel, Grayish Orange (10YR 7/4) in upper foot ± of interval, grading to moderate yellowish Brown (10YR 5/4) in remainder of interval. Some flecks of organic materials ~~in~~ ~~...~~ FC. Some core breaks. - Est. med plasticity, - med. to non friable - Sl. damp - wax. ~~13.6-15.4- Gravelly Clay~~ FC. Zone of Dark reddish brown (10R 3/4) clay from 13.3'-13.6' underlies very Gravelly, zone - gravelly clay, some sd.
	Run No. 5 12.0'-15.0'	Rec. 4.0' (1.0 s/...)					CL	13–15		13.6-15.4 Dark Reddish Brown (10R 3/4) in top 0.3' of core, and yellowish Gray (5Y 7/2) to moderate Brown (5YR 4/4) in remainder of interval. - Sl. damp & med. friable - wax
Box 3 of 3 15.4'-21.0'	Run No. 6 15.0'-18.0'	Rec. ~~...~~ 0.6 (0.6 s/0.3?)					GC	16–17		15.4-15.8 - Clayey Gravel - some sd. (based on one core fragment) - Matrix very Pale Orange (10YR 8/2) with Grayish Orange (10YR 7/4). Core dry. - Most of core consists of broken Quartzite Cobble. 15.8-18.0' No Recovery
	Run No. 7 18.0'-21.0'	Rec. 1.4'						18–20		~~18.0~~-19.4 - Top of bedrock - Actual depth questionable. Claystn. - some silt. - Brownish Gray (5YR 4/1) grading

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 3 OF 3

Borehole Number: 20098
Location - North: East:
Date: 6-25-98
Geologist: R. KOEHLER (Rig) F. Grigsby (Log)
Drilling Equip.: Geoprobe
Surface Elevation:
Area: North PA.
Total Depth: 21.0
Company: Tierra
Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 3 of 3	Run No. 18.0'-21.0	Rec. 1.4						20 21		18.0'-19.4 Continued - to light olive gray (5Y 6/1) at bottom of interval. - TO One-half inch of VFG. - Tan SS. or ~~sand~~ Alluvial Sand at top of interval. - May account for Non Recovery from 15.8' to 18.0'. Numerous random fractures FeO (Limonite) filled (Light Brown 5YR 5/6) ~~interval~~ to 19.1± ~~Fe Staining~~ This interval appears to be ~~...~~ reworked to brecciated). From 19.1± to 19.4', Core appears to be finely laminated (left crack over week-end cored?) No Recovery 19.4-21.0

NOTES. General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 20198
Location - North: ______ East: ______
Date: 6-29-98 / 6-30-98
Geologist: R. Koehler (Rig) F. Griggs (Log)
Drilling Equip.: Geoprobe
Surface Elevation: ______
Area: N. PA Plume
Total Depth: 16.0'
Company: Tierra
Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 0'-9.0'	Run No. 1 0.85-4.0'	Recov. 3.2'					SM	0–1		0.0'-0.8' 0.6' Asphalt, 0.2' Road base. 0.8-1.2' Silty Sand - some gravel - Road base Material. 1.2'-2.9' Gravelly Clay - some sd & silt. - Mixed with Asphalt - Fill Material. - Brownish Gray (5YR 4/1) clays in zones with Asphaltic material. Intervals of Predominantly clay are moderate yellowish brown (10YR 5/4). Very sl. damp when recovered - Clay plastic est. to be Med. very sl. damp.
							CL	1–3		2.9'-3.9' Clay - Some silt - Tr. Gravel. Pale yellowish brown (10YR 6/2) to light olive gray (5Y 6/1). Very sl. damp. dense - Indurated. - Est. med plasticity.
							SC	3–4		2.9'-3.9' - Clayey Sand - some gravel. pale yellowish brown (10YR 6/2) friable - dry. 3.9-4.0 - No Recovery
	Run No. 2 4.0'-7.0'	Recov. 4.0'					CL	4–9.5		4.0'-6.6' Sandy Clay. Tr. gravel. - Light olive gray (5Y - 5/2) grading to dark yellowish brown (10YR 4/2). Gravel imbedded in clay throughout interval. Very sl. damp. Indurated - dense. - Est. med plasticity. non friable. Extraneous material at 5.2'. 6.6'-9.5' - Clay - Some Sd. No Gravel. - Olive gray (5Y - 4/1) at top of interval - grading to Medium light Gray (N-5) at bottom of interval. - Trace coarse sd grains throughout interval. Core Vy. sl. damp. - Indurated.
Box 2	Run No. 3 7.0'-10'	Recov. 2.8'						9.5–10		9.5-16.0' - Top of Bedrock

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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401-…-30-0134-430W Form GT.1A (03/01/92)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20198
Location - North: ______ East: ______
Date: 6-29-98 / 6-30-98
Geologist: R. Koehler (Rig) E. Grigsby (Log)
Drilling Equip.: Geoprobe

Surface Elevation: ______
Area: N. PA. Plume
Total Depth: 16.0'
Company: Tierra Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 9.0'-16.0'	Run No. 4 10.0'-13.0'	Rec: 3.0' Includes 0.8' slough						10–13		9.5'-16.0': Continued Claystone. - Some silty intervals - Color grades from Grayish Orange (10YR 7/4) at top of interval to Pale yellowish brown (10YR 6/2) and Dark yellowish brown (10YR 4/2) over rest of interval. ~~Ironstone~~ Top of interval contains a concentration of small ~~Ironstone~~ Concretions. - Second concentration of ironstones at 15.5' to 15.8'. Larger, good core interval has ~~slight~~ Color change to Moderate brown (5YR 4/4) in interval. - ~~At~~ Over this Carbonaceous zone at approx. 13.4'-13.7'. Color change to Brownish Gray (5YR 4/1) This interval - Some FeO coated minor fractures occurring in lower 1.5'± of interval. Core is Vry. Sl. damp - ~~Hard~~ indurated to slightly friable. Entire ~~interval~~ interval appears highly to moderately reworked. / Most extensive occurring in upper portion of interval & decreasing with depth.
	Run No. 5 13.0'-16.0'	Rec: 2.0'						13–16	TD	

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20298
Location - North: ______ East: ______
Date: 7/1/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE
Surface Elevation: ______
Area: NORTH - PA
Total Depth: 13'
Company: TIERRA
Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature]
DATE 7-2-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0.0 - 9.8'	Run #1 0.0 - 4.0 ft.	Recovery 4.0 ft.						0.0		0.0-0.4 ft asphalt
								0.4		0.4-1.1 Sandy Gravel yellowish brown 10YR 5/4 gravel up to 1.5cm, rounded, unconsolidated, moist, roadfill. Material Dug out, Before Coring Not in Core Box
							use CL symbol	1.0 / 1.1		1.1 woven fiberglass (?) mat
							~~SC~~ CL	1.5		1.1-1.5 Gravely Clay, dark grayish brown to light olive brown (2.5Y 4/2 to 2.5Y 5.6), 3cm rounded gravel, moist, fractured; rock at bottom - igneous
								2.0		1.5-2.6 Old Asphalt
							CL	2.6 / 3.0		2.6-4.0 Gravelly Clay, as above ... dark grayish brown to light olive brown, some olive brown 2.5Y 4/2 2.5Y 5/6 2.5Y 4/3 rounded gravel up to 2.5cm, igneous mostly, moist, trace ironstone concretions
RDK 7/1/98	Run #2 4.0 - 7.0 ~~8.0~~ ft.	Recovery 2.85 ft.					CL	4.0 / 5.0 / 6.0		4.0-6.85 Clay with trace sand and gravel, Olive brown (2.5Y 4/4) to olive yellow (rare 2.5Y 6/3), Gravel 1-5mm, (one at ~4.5 ft), fine sand, moist Colors mottled, ~~some~~ rare 3mm - 5mm ironstone concretions Yellow parts may contain fine sand.
								6.85 - 7.0		No Recovery 6.85-7.0 ft
	Run #3 7.0 - 10.0 ft.	Recovery 4.0 ft. including 0.2 ft slough					CL	7.0		7.0-8.0 as above 4.0-6.85
							CL / CL	8.0 / 9.0		8.0-9.8 Gravely Clay, Black to very dark gray (5Y 2.5/1 to 5Y 3/1), rounded to subround igneous & metamorphic clasts up to 9.5cm, trace root hairs, massive, moist.
Box 2 of 2								9.8 / 10.0		No Recovery 9.8-10.0

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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437

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20298

Location - North: ________ East: ________

Date: 7-1-98 / 7-2-98

Geologist: R. Koehler (Rig) F. Griggsby (Log)

Drilling Equip.: Geoprobe

Surface Elevation: ________

Area: North PA Plume

Total Depth: 13'

Company: Terra

Project No.: ________

Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR

APPROVAL ________ DATE ________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
										(Compacted Slough above following interval)
Start 8.0' End 13.0'	From 8.8 To 13.0	Recovered 4.0'					CL	10		10.0 - 11.4 - Clay - Some sd. - Pred. Olive gray (5Y-4/1) Some disseminated mica flakes & very small gravel (some) Sl damp - Plastic & Loose - Some thin Caliche (?) seams -
								11		Top of Bedrock - 11.4
										Claystone - Some sd. - Tr. Caliche - Light Olive gray (5Y-5/2) - Not well defined Contact - Bedrock weathered (~~contacts~~) Some iron stained zones (Dark yellowish orange (10YR-6/6) Some thin Caliche filled Fractures
								12		
								13	TD	Core Sl. damp non friable - & non plastic.

NOTES. General: USCS is modified for this log as follows:

Materials amounts are estimated by % volume instead of % weight.

(1) Badly broken core, accurate footage measurements not possible.

(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20398
Location - North: East:
Date: 7/6/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation:
Area: NORTH - PA
Total Depth: 23'
Company: TIERRA Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR APPROVAL [signature] DATE 7-7-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 1 0.0 - 8.9	Run #1 0.0-4.0 ft.	Recovery 3.5 ft.						0.0		0.0-0.6 Asphalt. 0.0 to 1.1 not saved in core box. Dug out preparing flush mount hole.
								0.6		0.6-1.1 Road base, sandy Gravel, dk yellowish brn (10YR 4/4) rounded gravel to 2 cm, ig and sedimentary, medium sand, poorly graded, moist, unconsolidated. 1.1 ft depth of flush mount. woven cloth mat at 1.1 ft
							CL	1.1		1.1-2.0 ft Gravelly clay; brown (7.5YR 4/2) to olive gray (5Y 4/2) gravel up to 2.5 cm, subround, granitic?, grades to sand (CS), plastic moist, unconsolidated
								2.0		2.0-2.5 ft, Asphalt
							CL	3.0		2.5-4.0 ft Gravelly Clay, grayish brown (2.5Y 5/2) to olive brown (2.5Y 4/3) subround to angular clasts to 3 cm, rotten granitic, some qtzite, tr wood frag (burned?) 0.2 ft med sand at 3.6 ft. light olive brown (2.5Y 5/6) moist, plastic, unconsolidated, massive) 0.0 ft RPK 7/6/98
	4.0	4.0								
	Run #2 4.0-7.0 ft.	Recovery 3.7 ft		30				4.0		4.0-5.5 Clay, mottled grayish brown (2.5Y 5/2) to light yellowish brn (10YR 6/4) some patches brownish yellow (10YR 6/6), trace medium sand (in fracture?) 4.4 ft, trace angular gravel at 4.8 ft, possibly some clay clasts, moist, massive, plastic
				H			CL	5.0		
								5.5		5.5-7.0 Clay; Clay clasts gray (10YR 5/1) in light yellowish brown (2.5Y 6/4) to olive yellow (2.5Y 6/8) matrix, possibly a random fracture - two, breaks into small blocks, or irregular fragments, moist, only slightly plastic,
								6.0		
	7.0	7.0						7.0		7.0-7.9 Clay as above 5.5-7.0 slightly less blocky fracturing more massive, slightly more plastic, more moist.
8.9	Run #3 7.0-10.0 ft	Recovery 2.4 ft. including 0.2 ft slough					SM	7.9 / 8.0		7.9-8.8 Gravelly Sand; dark yellowish brown (10YR 4/4) fractured quartzite (?) gravel up to 2.5 cm, coarse angular sand, granitic clasts, clayey, moist, massive, unconsolidated. SL [illegible]
8.9							CL	8.8 / 8.9 / 9.0		8.8-9.4 Clay as above 5.5-7.0 SL [illegible]
								9.4		9.4-10.0 No Recovery
								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20398
Location - North: East:
Date: 7/6/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation:
Area: NORTH-PA
Total Depth: 23'
Company: TIERRA Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 7-8-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
	13.0 Run #4 10.0-13.0 ft	Recovery 2.8 ft including 0.2 ft slough					CL	10.0		10.0-11.1 Sandy Clay, Gray (10YR 5/1) clay clasts in clay-sand matrix (gray to yellowish brown (10YR 5/8)), fine sand poorly graded, massive, moist, plastic although unconsolidated
							CL	11.0 / 11.1		11.1-11.7 Clay as above 5.5-7.0, prominent clasts, more moist than 5.5-7.0
							CL	11.7 / 12.0		11.7-12.8 Clay-Sand Gravel, Clay at top decreases down yellowish browns (10YR 5/4-5-6) with weak red (10R 4/4) mottles, gravel up to 2cm, rounded, granitic, medium to coarse sand, poorly graded, unconsolidated, lower sandier part wet,
								12.8		12.8-13.0 No Recovery
	13.0 Run #5 13.0-16.0 ft 16.0	Recovery 2.1 ft					CL	13.0		13.0-13.4 Clay Sand Gravel as above 11.7-12.8 -wet-
								13.4		13.4-13.9 Clay Sand (trace gravel), light olive gray (5Y 6/2) fine sand, massive, wet,
							CL	13.9 / 14.0 / 15.0		13.9-15.1 Gravely Clay; dark olive gray (5Y 3/2) to black (5Y 2.5/2) Gravel to 2 cm, rounded, plastic, moist to wet, root hairs,
								16.0		15.1-16.0 No recovery
	16.0 Run #6 16.0-19.0 ft	Recovery 0.9 ft including [illegible] slough					CL	17.0		16.0-16.9. Clay - Tr. gravel - Dark Yellowish Brown (10YR 4/2) some silt & sand in lower of interval with 5% - change to Pred Grayish Orange (10YR 7/4) Large gravel clast at bottom of interval. Core Mod Damp - Pliable - Less Med. Plasticity,
								18.0		16.9-19.0. No Recovery
	Run #7 19.0-22.0	Recovery 1.0 ft incl. 0.6 slough						19.0 / 20.0		19.0-19.6. Top of Bedrock Claystone. Interbedded Dark Yellowish Brown (10YR 4/2) and Grayish Orange (10YR 7/4) beds well defined. Horizontally horizontal - Upper Part of Core Damp & pliable - becomes blocky & indurated at bottom of interval. 19.6-22.0. No Recovery

NOTES: General: USCS is modified for this log as follows:
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20398
Location - North: ______ East: ______
Date: 7/1/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation: ______
Area: NORTH - PA
Total Depth: 23'
Company: TIERRA Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL: [signature] DATE 7-8-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
	Run #7 19.0-22.0	Recovery						20.0 – 22.0		
	Run#8 22.0-23.0	Recov 0.85ft						22.0 – 23.0		claystone 22.0-23.0 Clay, brn to dk brn (7.5YR 4/2) patches of strong brown (7.5YR 5/8), carbonaceous, firm, ~~[illegible]~~ [illegible] RPK mmas plastic, massive, moist [illegible] quartz is frosted.
								23.0	TD	
								24.0		
								25.0		
								26.0		
								27.0		
								28.0		
								29.0		
								30.0		

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: 20498
Location - North: East:
Date: 7/7/98 7/8/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE/MACROCORE
Surface Elevation:
Area: NORTH - PA
Total Depth: 22'
Company: TIERRA Project No.:
Sample Type: PUSH/ CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 7-9-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/ LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3 0.0 to 10.0 ft	Run #1 0.0-4.0 ft	Recovery 4.0 ft (3.4 ft in core barrel, dug out 1.0 ft for flush mount)				open hole		0.0		0.0-0.5 ft Asphalt — Not saved in core box
								0.5		0.5-1.2 ft Sand and Gravel, yellowish brown (10YR 5/6) rounded gravel to 2cm, igneous-granitic, coarse sand, unconsolidated, moist, woven mat @ 1.2 ft
						1.2 actual core interval	GC	1.2		* 1.2-1.6 Gravel-Sand-Clay, Yellowish brown (10YR 5/4) to black (10YR 2/1), rounded gravel to 1.5cm, moist, plastic, well graded
								1.6		1.6-2.1 Asphalt - crumbled
								2.1		* 2.1-2.6 Gravel-Sand-Clay As Above 1.2-1.6, sand med to crs, gravel granitic,
							(1)	2.6		2.6-4.0 Gravelly Clay, mottled (10YR 5/2) grayish brown, brownish yellow (10YR 6/8) and dark gray (10YR 4/1), rounded but fractured gravel to 2.5cm, granitic, rare layer (<0.5cm) fine sand, clay clasts, moist, plastic to slightly plastic, gravel and sand associated together for the most part.
	Run #2 4.0-7.0 ft	Recovery 2.1 ft (unsaved top 0.2 is slough)					GC	4.0		4.0-5.7 Clayey Gravel, (top 0.2 olive brown (2.5Y 4/3) clay may be slough), dark yellowish brown (10YR 3/4), fractured granitic & quartzite gravel up to 3cm, slightly moist, slightly plastic, poorly graded,
							SC	5.7		5.7-6.1 clayey Sand, brownish yellow (10YR 6/3), rounded, quartz, medium (USC), moist, massive, unconsolidated,
								6.1		6.1-7.0 No recovery
	Run #3 7.0-10.0 ft	Recovery 3.4 ft including 0.2 ft of slough					SC	7.0		7.0-9.6 Clayey Sand with gravel, brownish yellow (10YR 6/6 to 6/8) some strong brown (7.5YR 5/8). Angular to subround gravel up to 3cm, quartzite in part, sand dominantly fine grained but grades up to coarse, crudely bedded (1 zone 0.5 ft from about 7.8 to 8.3 ft), well graded, plastic, moist,
							(C)	9.6		9.6-10.0 ~~Clay~~ Gravelly Clay, black (10YR 2/1), gravel up to 2cm, massive, moist, plastic, root hairs.
								10.0		

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* - Both intervals pred. Sandy Gravel - Sandy Clay - GC(?) Mixed with some Asphalt

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~~443~~

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: 20498
Location - North: ______ East: ______
Date: 7/8/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation: ______
Area: NORTH-PA
Total Depth: 22'
Company: TIERRA Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 7-23-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 10.0 to 20.0 ft	Run #4 10.0-13.0 ft	Recovery 4.0 ft including 0.3 ft of slough.					CL ~~SC~~	10.0 – 11.0 – 12.0		10.0-13.0; Sandy Clay ~~Clayey Sand~~ with occasional gravel; top 0.5 ft olive gray (5Y 4/2) to dk olive gray (5Y 3/2) most of rest olive (5Y 5/3-5/4) to olive yellow (2.5Y 6/6), light gray mottling (especially bottom 0.7 ft) (2.5Y 7/0); granitic (some rotten) and quartzite gravel to 3 cm, sand fine, subangular to subround, plastic, moist, root hairs 10.7 to 11.2 ft.
	Run #5 13.0-16.0 ft	Recovery 2.5 ft (No obvious slough)					CL	13.0		13.0-13.5 Sandy clay ~~Clayey Sand~~ As above 10-13.0 no gravel here, olive (5Y 5/3 to 5/4) with olive yellow to yellow along small fractures (5Y 6/8 to 5Y 7/8) plastic, moist
							CL	14.0		13.5-15.1; Sandy Clay ~~Clayey Sand~~ with occasional gravel; dark gray to very dark gray (5Y 4/1 to 3/1), granitic and quartzite gravel to 2.5 cm - fractured, moist, plastic, root hairs throughout massive, poorly graded. Sand - fine grained
							GC	15.0 / 15.1 – 15.5		15.1-15.5 Sandy Gravel, brown (10YR 5/3), fractured quartz to 2.5 cm, in med to crs sand matrix, wet ← just at very bottom!
								15.5 – 16.0		15.5-16.0 No Recovery
	Run #6 16.0-19.0 ft	Recovery 1.7 ft including 0.5 ft of possible slough. Rest of core liner filled with soupy - clay/sand/gravel					GC	16.0		16.0-16.5 Sandy Gravel as above 15.1-15.5 Very wet,
							CL			16.5-~~16.8~~ 16.9 Sandy clay ~~Clayey Sand~~, lt yellowish brown (10YR 6/4) to brownish yellow (10YR 6/6), fine sand, firm, possibly laminated, plastic moist
								17.0		16.9-17.7 ~~Clay~~ Claystone sandy at top sand decline down, Grades from overlying sand above to light gray at bottom (mottled 2.5Y 7/1 to 7/2), may be bedded, sandy top sand disappears quickly down, firm, plastic, moist.
								RPK 7/8/98 17.7 – 18.0 – 19.0		No Recovery (17.7) ~~17.2~~ RPK -19.0 ft Core barrel filled with soupy clay/sand (fine) / Gravel (≤1 cm, angular) mess. flowing. ~~Top 0.5 ft in core box may be real or may be slough - not shown here.~~ RPK / 7-8-98
	Run #7 19.0-22.0 ft	Recovery 3.0 ft includes 0.2 ft slough						19.0 – 20.0		19.0-21.8 ~~Clays~~ FG. Claystn. moist, firm, dries out and becomes crumbly at bottom.

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* 16.9-17.7 Claystone - Top of Bedrock

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1/3 OF 3

Borehole Number: 20499
Location - North: East:
Date: 7/8/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation:
Area: NORTH - PA
Total Depth: 22.0'
Company: TIERRA
Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Brigsby DATE 7-23-98

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAINSIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 3 of 3 20.0-22.0 ft	Run #7 19.0-22.0 ft	Recovery 3.4 ft including 0.2 ft gravelly slough						20.0		
								21.0		
								21.8		
								22.0		No Recovery 21.8 - 22.0 ft.
										Bedrock probably between 21 and 22.0 ft.
								23.0		
								24.0		
								25.0		
								26.0		
								27.0		
								28.0		
								29.0		
								30.0		

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: 20598
Location - North: East:
Date: 07-13-98
Geologist: R. KOEHLER ~~KOEHLER~~ / F. Gregsh
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation:
Area: NORTH - PA
Total Depth: 20.5'
Company: TIERRA Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0.0-12.5	0.0/1.4	1.4						0.0		0.0-0.5 Asphalt
										0.5-1.4' - Road Base - Not Recovered
	Run No. 1 0.5'-4.5'	Rec. 3.3'					GC	1.0-4.0		1.4-4.5 - Clayey Gravel - Very Dark Gray (10YR-3/1) - Some roots at top. Clay stiff - Est. Med high plasticity. Core becomes sandy in lower 0.5 Core along with Color change to Brown (10YR-4/3) Sandy
	Run No. 2 4.5'-8.5'	Rec. 3.0'					CL	5.0-7.0		~~4.5~~ 4.5-7.5 - Silty Clay - Some Sand & Gravel - Color Brownish Yellow (10YR-6/6) with Dark Yellowish Brown (10YR-4/4) from 4.5-5.0 changing to Dark Yellowish Brown (10YR 4/4) to 6.3. From 6.3-7.5 Pred. Very Dark Gray (10YR-3/1) with Very Pale Brown (10YR-7/3) and some green clay - Sl. damp Est. Med. plasticity
										7.5-8.5' - No Rec
								8.0		8.5'-9.8' - Silty Clay - Some Gravel - Gravel abundant in top half of interval (poss. slough) Color Pred. Olive gray (5Y-5/2) with some Fe staining (Yellow - 10YR-7/6) Est. Med-low plasticity - Sl. friable Sl. damp
	Run No. 3 8.5'-12.5'	Recovered 3.7					CL	9.0		9.8'-12.2' Silty Clay - Some Sd & gravel - Color Pred. Dark grayish brown (10YR-4/2) Roots throughout the interval - Core Sl. damp - Friable - Est. Med-Low plasticity. Gravel to +1" - Pred. quartzite
							CL	10.0		12.2'-12.5 - No Recovery

NOTES: General: USCS is modified for this log as follows:
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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20598
Location - North: East:
Date: 2-13-98
Geologist: R. KOEHLER FG. F. Grigsby
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation:
Area: NORTH-PA
Total Depth: 20.5'
Company: TIERRA
Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL
DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 12.5'-20.5'	Run No. 3 8.5'-12.5'	Rec. 3.1'					CL	10.0 – 12.0		~~12.5-14.3~~ 12.5-14.2 DG Clayey Gravel - some silt & sd. - Gray (10YR-5/1) in upper half color change to olive gray (5Y. 5/2) in lower half of interval. Few sandy zone in approx. middle of interval - core dry to sl. damp - est med. plasticity.
	Run No. 4 12.5'-16.5'	Rec. 3.1'					GC	12.0 – 16.0		~~12.5~~ *14.2 20.5 DG - Top of Bedrock. Claystone. Trace of Caliche seams. Color light olive brown (2.5Y - 5/3) to Grayish brown (2.5Y - 5/2) - Well defined contact with alluvium (based on gravel at contact) core very slightly damp - moderately indurated. Few fractures but some fe stained zones (Color brownish yellow - 10YR - 6/6 to yellowish brown 5/6). Core possibly reworked in upper portion of interval - becomes blocky (massive) with depth
	Run No. 5 16.5'-20.5'	Rec. 4.0'						16.0 – 20.0		X - 16.2' - 16.5 No Recovery

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20598
Location - North: ______ East: ______
Date: 7-15-98
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: ______
Area: North PA Plume
Total Depth: 20.5'
Company: Tierra Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Bot 2/2	Run No 5							20		
								20.5		TD

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: 20698
Location - North: ______ East: ______
Date: 07-14-98
Geologist: ~~R. KOEHLER~~ E. Griggs
Drilling Equip.: GEOPROBE/MACROCORE

Surface Elevation: ______
Area: NORTH - PA
Total Depth: 24.0
Company: TIERRA Project No.: ______
Sample Type: PUSH/CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3 0.0 - 12.5								0.0		0.0 - 0.5' Asphalt
										0.5 - 1.2' Base Material - Gravel sd & Clay
	Run No. 1 0.0 - 4.5	Recovered 3.3'					CL	1.0		1.2' - 1.9' Sandy Clay - some Gravel - Grayish Brown (5YR 3/2) Mat at top of Core - some asphalt mixed with material Est Medium plasticity - Dry
							GC	2.0 / 3.0		1.9 - 3.9' Clayey Gravel - some sand - Matrix Brownish Black (5YR 2/1) to Grayish Brown (5YR 3/2) Estimated Mod plasticity - core Dry - Gravel well graded, max size [illegible]
							CL	4.0		3.9' - 4.5' Sandy Clay, Tr. gravel - moderate yellowish brown (10YR 5/4) with some dark yellowish orange (10YR 6/6) - core dry - Est Med plasticity
	Run No. 2 4.5' - 8.5'	Recovered 4.0'					CL	5.0 / 6.0		4.5' - 7.7' - Sandy Clay - tr. fraction of Gravel - Same as Sandy Clay 3.9 - 4.5
								7.0		7.7' - 8.0' - Clayey Gravel - some broken Cobbles - Matrix Moderate yellowish brown (10YR 5/4) Core dry - Est. Med plasticity
							GC	8.0		
							CL			8.0 - 8.7 - Sandy clay - same as 7.7 - 8.0
	Run No. 3 8.5' - 12.5'	Rec. 2.9'					CL	9.0		8.7' - 9.8' - Sandy Clay - some gravel - with 0.15' Cobble zone at top of interval. Mottled - Colors Moderate yellowish brown (10YR 5/4) and Pale yellowish brown (10YR 6/2)
								10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20698
Location - North: ________ East: ________
Date: 07-14-98
Geologist: R. KOEHLER F. Grasb[illegible]
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation: ________
Area: NORTH-PA
Total Depth: 24.0'
Company: TIERRA
Project No.: ________
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ________ DATE ________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 10.4 - 22.2'	Run No. 3 8.5' - 12.5'	Rec: 2.9'					CL	10.0 – 11.0 – 12.0		8.7 - 9.8 - Contin[illegible] - Core Sl. damp - Est. med plasticity Some Carbonaceous material. 9.8' - 10.8' Silty clay - Some Sand - Sl. damp - Sl. friable - Pale yellowish brown (10YR 6/2) with some dark yellowish orange (10YR 6/6) specks & mottling. Est. low to med plasticity. 10.8' - 11.4' - Gravelly Clay - ~~Some Sd~~ Matrix Pale yellowish brown (10YR 6/2) with dark yellowish orange (10YR 6/6) streaks & spots Est. low to med plasticity Sl. damp. 11.4 - 12.5' - No Recovery
	Run No. 4 12.5' - 16.5'	Recovered 2.7'					CL / GC	13.0 – 14.0 – 15.0 – 16.0		12.5' - 13.1 - Gravelly Clay - Same as ~~[illegible]~~ 10.8 - 11.4' 13.1 - 13.9' - Clay - Tr Sd - Silt & gravel Pale yellowish Green/(10YR 8/2) with dark yellowish orange (10YR 6/6) streaks & spots. Sl. damp - Sl. friable - Est Med plasticity. 13.9 - 15.2 - ~~Gravelly Clay~~ [illegible] Clayey Gravel - Matrix Dark yellowish Brown (10YR 4/2) - Gravel well graded - pred quartzite - Est. Med plasticity (matrix). 15.2 - 16.5 - No Recovery
	Run No. 5 16.5' - 20.5'	Recovered: 3.3'					GC	17.0 – 18.0 – 19.0 – 20.0		16.5' - 19.8 - Clayey Gravel - Same as 13.9 - 15.2 except very Sandy at Top of interval

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A REV. 2

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20698
Location - North: ______ East: ______
Date: 07-14-98
Geologist: ~~R. KOEHLER~~ FGF. Grigsby
Drilling Equip.: GEOPROBE/MACROCORE

Surface Elevation: ______
Area: NORTH-PA
Total Depth: 24.0'
Company: TIERRA Project No.: ______
Sample Type: PUSH/CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

INTERVAL OF CORE BOX	RUN NO. OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH (FT)	GRAPHIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 20.4'-22.2'	Run No. 5							20		19.8'-20.5' - No Recovery FG. 19.3-20.4 ~~20.5-20.4~~ Clayey Gravel (same as 13.9'-15.2') recovered as slough and as possible lost core from 19.8-20.5. Measuring from bottom of core the top of bedrock should be at approx. 20.4. Therefore most of the lost core was recovered.
Box 3 of 3 22.2-24.0	Run No. 6 20.5'-24.0	Recovered 4.0						21, 22, 23, 24		20.4'-24.0' - Claystone - Top of Bedrock Slightly silty - Color Pred. Olive Gray (5Y 4/1) Core dry mod. indurated - Core appears disturbed (Reworked?)
									TD	

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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2) Core breaks cannot be matched, accurate footage measurements not possible.

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RF-46530 (Rev. 6/93) Form GT.1A (03/01/93)

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT — FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20798
Location - North: ______ East: ______
Date: 7/15/98
Geologist: ~~R. KOEHLER~~ J. BOYLAN
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation: ______
Area: NORTH - PA
Total Depth: 29'
Company: TIERRA
Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

~~EG&G~~ RMRS LOGGING SUPERVISOR APPROVAL: Fred Grigsby — DATE: 9-7-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
BOX 1 OF 3 : 0.0 - 10.1 — 0.0	0.0 RUN 1: 0.0-1.2' / 1.2	0.0 / 0.0 / 1.2						0.0 – 1.2		NO RECOVERY 0.0-1.2'. Asphalt, fill — asphalt is 0.0-0.5', fill 0.5-1.2', then geomembrane. Excavated for manhole installation, so no core recovered.
	1.2 RUN 2: 1.2-5.2	3.8						1.2 – 2.3		Mixed asphalt & fill — predominantly black. Geomembrane at top. Slightly moist. Some fine gravel component. Grades to organic-rich clay at base.
							CL	2.3 – 5.0		Clay with silt and traces sand and gravel — Mottled colors, generally lightening below 3.0'. Above this, predominantly dusky brown to dusky yellowish brown (5YR to 10YR 2/2); below, predominantly moderate to dark yellowish brown (10YR 5/4 to 4/2). Sl. moist. Gravelly at 3.5-3.9', less so 3.9-4.5'. Gravels mainly quartzite, >0.5".
								5.0 – 5.2		NO RECOVERY ~~5.0~~ 5.0-5.2'
	5.2 / 5.2 RUN 3: 5.2-8.0	5.2 / 5.2 / 2.4						5.2 – 7.6		Same as above, 2.3-5.2' w/coloration similar to that below 3.0'. As with above material, colors are mottled, including reds, olive grays, browns, but predominantly as stated above. Sl. moist. Breakage pattern more chippy below 7.0'.
								7.6 – 8.0		NO RECOVERY, 7.6-8.0'
TO 10.1	8.0 RUN 4: 8.0-~~11.0~~ 11.3	8.0 / 4.0' incl. 0.8' of compacted slough						8.0 – 10.0		Same as above, 5.2-7.6; predominant color now ~moderate yellowish brown (10YR 5/4). Sl. moist. Occasional zones of imported bedrock/reworked bedrock, some of which are siltstone to very fine grained sandstone. (See especially 8.0-8.1', 11.2'.) Trace scattered gravels, mainly quartzite.

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Materials amounts are estimated by % volume instead of % weight.
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

401-450-0134-450X Form GT.1A (03/01/92)

45+448

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20798
Location - North: ______ East: ______
Date: 7/15/98
Geologist: ~~R. KOEHLER~~ J. BOYLAN
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation: ______
Area: NORTH - PA
Total Depth: 29'
Company: TIERRA
Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL [signature] DATE 9-7-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
10.1	↑ RUN 4 cont'd	see previous page					CL	10.0, 11.0		see previous page
Box 2 of 3: 10.1 - 19.0	11.3 / 11.3 RUN 5: 11.3 - 14.3	11.3 / 11.3 3.5' incl. 0.3' slough						11.3, 12.0, 13.0, 14.0		Same as above, 8.0-11.3'. Chippy breaking pattern. Single gravel clast (½") @ base of run, in place (broken by crew); small (½" sandy (med-fine gr.) pocket @ 13.0-13.1' contains whitish-pinkish grains (Kspar?). Occasional carbonaceous fragments, some w/woody appearance. Very similar in appearance, overall, to bedrock claystone - except for clastics and alluvial clay zone @ 11.5'.
	14.3 / 14.3 RUN 6: 14.3 - 16.3	14.3 / 14.3 2.3' incl. 0.2' slough						14.3, 15.0, 16.0		Same as above, 11.3-14.3. color changes below 14.7 to dark yellowish brown, 10YR 4/2. Gravel lens @ 15.0-15.3', 15.7'; below 15.7' lens, traces gravel in clay. Slightly moist; moist to wet @ 15.7', but no free water - just squishy clay. Gravels to >1"
	16.3 / 16.3 RUN 7 16.3 - 19.0	16.3 / 16.3 1.5' incl. 0.3' slough						16.3, 17.0, 17.5, 18.0		Same as above, 14.3-16.3, w/ gravel lenses @ 16.7-17.0', 17.2-17.4'. Saturated. Gravels to >1". Traces roots @ bottom of recovery.
										NO RECOVERY 17.5 - 19.0'
19.0 / 19.0 Box 3 of 3	19.0 / 19.0 RUN 8: 19.0 - 23.0	19.0 / 19.0 1.2' incl. 0.5' slough					GC/CL	19.0, 19.7, 20.0		Clayey gravel to gravelly clay - Same as above, 16.3-17.5', but more gravel. Saturated, goopy. Fresh K-spar clast @ base of recovery. Dark yellowish brown (10YR 4/2).
										NO RECOVERY 19.7 - 23.0'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 3 OF 3

Borehole Number: 20798
Location - North: East:
Date: 7/15/98 & 07-16-98
Geologist: R. KOEHLER J. BOYLAN & F. Grigsby
Drilling Equip.: GEOPROBE/MACROCORE
Surface Elevation:
Area: NORTH-PA
Total Depth: 29'
Company: TIERRA
Project No.:
Sample Type: PUSH/CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL DATE

Run / Interval	Feet of Core Recovered	USCS	Depth (ft)	Sample Description
Run 8 cont'd 19.0-23.0	see previous page		20.0–23.0	NO RECOVERY 19.7 - 23.0
Run No. 9, 23.0-26', Recovered 1.5' including 0.3' slough (Box 3 of 3, 19.0'-29.0')	23.0 / 23.0	CL	23.0–24.1	23-24.1 Silty Clay - Some sd & Granite Cobble at bottom of interval (3/4 inch thick ±) Core mottled - Colors vary from Moderate Yellowish Brown (10YR-5/4) to Light Olive Gray (5Y 5/2). Core wet Clay pliable - Est. Med. plasticity one granitic Coble at bottom of interval. 24.1'-26.0' - No Recovery
Run No. 10, 26.0-29.0, Rec 2.2' including 0.5' slough		GC	26.0–27.9	26.0'-26.2' - Clayey Gravel - One large Granitic Pebble - appears in place - Clay Pred. Dusky yellowish brown (10YR 2/2) - Wet, sticky & pliable. 26.2'-27.9' - Claystone - Top of Bedrock - Color varies from pale yellowish Brown (10YR-6/2) to moderate yellowish brown (10YR-5/4) (related to Fe Staining) - Overall Interval appears reworked/disturbed. Core sl damp - somewhat pliable at top - more competent at bottom of interval - 27.7-29.0' - No Recovery
		TD	29.0	

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 20898
Location - North: ______ East: ______
Date: 07-16-98
Geologist: ~~R. KOEHLER~~ PG. F Grigsby
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation: ______
Area: NORTH - PA
Total Depth: 16.0'
Company: TIERRA Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
							SM	0.0		0.0'-0.6'- Gravelly Sand - Some Silt - Mixed with some Asphalt - Dominant Color Brownish Black (5YR-2/1) because of Asphalt.
							SM	1.0		0.6'-1.3'- Gravelly Sand - Pale yellowish Brown (10YR-6/2) Sand Poorly Graded - Pred F.G. - Gravel - Poorly Graded Pred. 1/4"-1/2" ± Fill Material - No Asphalt
	Run No. 1 0.0'-4.0'	Rec. 2.3'					CL	2.0		1.3'-2.3' Gravelly Clay - Pred. Dark yellowish Brown (10YR-4/2) Sl. damp - Dense - Gravel consist of Large Aggregate Most up to 2" in length -
								3.0		2.3-4.0'- No Recovery
Box 1 of 2 0.0'-16.0'								4.0		
								5.0		4.0'-8.6'- Clay - Tr. sd & Gravel. Color Pred. Brownish gray (5YR-4/1) with Some Dusky yellow (5Y-6/4) Streaks Prevalent Gravel zone from 7.8-8.0 ~~7.8-8.0~~ Core dry - dense -
	Run No. 2 4.0'-8.0'	Rec. 4.0'					CL	6.0		8.6'-9.1 ~~Clayey Gravel~~ with some sd. ~~damp~~ to Wet
								7.0		
								8.0		
	Run No. 3 8.0'-12.0'	Rec. 4.0'					GC	9.0		9.1-15.7' Gravelly Clay - Tr. sd. Brownish Gray (5YR-4/1) - Reworked Bedrock & alluvium. Damp -
							CL	10.0		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM PRO.101A

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE BOREHOLE LOG

PAGE 2 OF 2

Borehole Number: 20898

Location - North: ______ East: ______

Date: 07-16-98

Geologist: E. Grigsby

Drilling Equip.: Geoprobe

Surface Elevation: ______

Area: North PA

Total Depth: 16.0

Company: Tierra

Project No.: ______

Sample Type: Continuous Core

RMRS LOGGING SUPERVISOR

APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1	Run No. 3 8.0'-12.0'	Rec. 4.0'						10–12		
Box 2 of 2 10.0'-16.0'	Run No. 4 12.0'-16.0'	Rec. 4.0'					CL	12–15		
								15–16		Top of bedrock - Claystone - Brownish Gray (5YR-4/1) some dusky yellow (5Y-6/4) (FeO) streaks. Some crudely horizontal bedding. Sl. damp.
								16	TD	

NOTES: General: USCS is modified for this log as follows:

Materials amounts are estimated by % volume instead of % weight.

(1) Badly broken core, accurate footage measurements not possible.

(2) Core breaks cannot be matched, accurate footage measurements not possible.

Procedure No. RMRS/OPS-PRO.101

Revision 0

Date effective: 12/31/98

4011-930-0134-930X Form GT.1A(03/01/97)

455452

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 20998
Location - North: ______ East: ______
Date: 08-18-98
Geologist: F Grigsby
Drilling Equip.: Geoprobe

Surface Elevation: ______
Area: North PA Plume
Total Depth: 11.0'
Company: Terra/Smith Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
	Run No. 1 0.0-4.0'	Rec: 2.7'					CL	0		0-1.3' Silty Clay - some gravel & sd. - Top soil interval - some roots - Pale Yellowish Brown (10YR 6/2) to Dark Yellowish Brown (10YR 4/2) some mod. Yellowish Brown (10YR 5/4) FeO staining. Core Dry - wx - friable.
							Cl	2		1.3'-2.7' - Silty Clay - Tr gravel - Fill - same as above except composed of some claystone fragments. More abundant FeO staining - less gravel some roots
								3		2.7-4.0' No Rec.
Box 1 of 2 0.0'-8.8'	Run No. 2 4.0'-8.0'	Rec. 4.0'					Cl	4		4.0'-4.8' - Clay - some silt, Tr. Gravel & sd. Grayish Brown, ~~(5YR 3/2)~~ very sl. damp - dense to indurated, wx. 4.8'-~~8.0~~ 6.4' - Clay - some silt. Color change to yellowish Brown (10YR 5/4). Core sl. damp - pliable
							CL	6		6.4'-8.0' Clay - Some gravel - Clay similar to above with gravel intervals, and some zones of Dark yellowish orange (10YR 6/6) med. heavy FeO staining - Core sl. damp - friable.
							Cl	7		8.0'-8.3' - Clay - same as 4.8'-6.4'
	Run No. 3 8.0'-11.0'	Rec. 2.6'					CL	8		8.3'-10.0' Clay - Light olive gray (5Y-6/1) with moderate yellowish Brown (10YR 5/4) Intermixed Clay & Claystone fragments - Core Cohesive - very sl. damp. ~~Predominantly Brownish Gray (5YR 4/1) becomes more compact~~ FG.
88206 / 8.8'-...							CL	9		
								10		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 20998
Location - North: East:
Date: 08-18-98
Geologist: E. Grigsby
Drilling Equip.: Geoprobe
Surface Elevation:
Area: North PA Plume
Total Depth: 11.0'
Company: Tema/RMRS Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2	Run No. 3 8.0-11.0	Rec. 2.6'						10		10.0 - 10.6 - Top of bedrock - Transitional - Probably reworked - Predominately Brownish Gray (5YR 4/1) Becomes more competent at bottom of interval. Some convoluted structure
								11		10.6 - 11.0 - No recovery
								12		Measured Depth = 10.9' Top of bedrock should be adjusted to 10.3'
								13		
								14		
								15		
								16		
								17		
								18		
								19		
								20		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21098
Location - North: ________ East: ________
Date: 07-20-98
Geologist: R. KOEHLER F&F. Grigsby
Drilling Equip.: GEOPROBE/MACROCORE

Surface Elevation: ________
Area: NORTH - PA
Total Depth: 20.0'
Company: TIERRA Project No.: ________
Sample Type: PUSH/ CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ____________ DATE ____________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3 0.0'-9.6	Run No. 1 0.0-4.0'	Rec. 3.3'					GC	0.0 – 4.0		0.0'-3.3' - Gravelly Clay - Some sd. - Color Moderate yellowish Brown (10YR-5/4) with Dark Yellowish Brown (10YR-4/2) to 2.7'. Color change to ~~Dark~~ Dusky Yellowish Brown (10YR-2/2) at that depth. Clayey zones at 1.6 to 2.0' and 2.7' to 3.3' sandy interval at 2.0-2.2', & Gravel zone at 1.2-1.3'. Core dry. Clay dense to indurated. some FeO staining (Dark Yellowish orange, 10YR-6/6) in upper half of interval. zone ux. - Probably fill.
								3.3 – 4.0		3.3-4.0' - No Recovery
	Run No. 2 4.0'-8.0	Rec. 4.0					CL	4.0 – 4.8		4.0-4.8 - Gravelly Clay - same as 2.7 to 3.3' above except more Gravel. Color Dusky Yellowish Brown (10YR-2/2) - Very dense, - Dry -
							CL	4.8 – 6.0		4.8-6.0' sandy clay - Moderate ~~Yellowish~~ Brown (5YR-4/4) to Moderate Brown (5YR-3/4) - Core very sl. damp - sl. friable.
							SM	6.0 – 6.5		6.0'-6.5 - sandy Gravel - some clay Matrix Moderate Brown (5YR-4/4). sl. Damp - friable Gravel ~~tore~~ large - Possible Broken Cobbles.
							CL	6.5 – 7.4		6.5'-7.4' Sandy Clay - Moderate Brown (5YR-4/4) - Very sl. Damp - Mod. Friable ux.
							SM	7.4 – 8.0		7.4'-8.0 Gravelly Sand - Some Clay Dusky Yellow (5Y-6/4) to Moderate
	Run No. 3 8.0'-12.0'	Rec. 2.6'				~~SC~~ FC	CL	8.0 – 9.0		
						Fc	~~GC~~	9.0 – 10.0		

change to cl symbol

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

48455

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21098
Location - North: ______ East: ______
Date: 07-20-98
Geologist: ~~R. KOEHLER~~ FGF. Brazeby
Drilling Equip.: GEOPROBE / MACROCORE
Surface Elevation: ______
Area: NORTH-PA
Total Depth: 20.0'
Company: TIERRA
Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
	Run 3			Change to Cl Symbol			~~GC~~ CL	10.0		7.4-9.0 continued Brown (5YR-4/4) Abundant FeO staining. - Core well ox. - Very sl. damp. Mod. friable to friable - Sand v-f
								11.0		9.0-9.5 Sandy Clay - Dark yellowish Brown (10YR-4/2) with some Moderate yellowish Brown (10YR-5/4) streaks & flecks - some orange flecks - This may be slough
	Run No. 4 11.0'-14.0'	Rec: 3.3'					~~GC~~ Cl	12.0		
								13.0		9.5'-~~11.0~~ 10.6' Gravelly Clay - Some to abundant sand. Dominant Color Moderate yellowish Brown (10YR-5/4) & Pale yellowish Brown (10YR-6/2) Abundant FeO staining (light brown 5YR-5/6) Core varies from dense to mod. friable - depending on sand content. Very sl damp - ox.
Box 2 of 3 9.6'-18.2'								14.0		
	Run No. 5 14.0'-17.0'	Rec: 2.8'					SW	15.0		
								16.0		10.6'-11.0' NO Recovery 11.0'-12.6' Gravelly Clay - same as 9.5'-10.6'.
							SC	17.0		12.6'-16.4' - Gravelly Sand - Pred. Light Brown (5YR-5/6) - Damp - sand well graded - Int. ox - oxidized.
	Run No. 6 17.0'-20.0'	Rec: 3.0'						18.0		16.4-18.2' - Clayey Sd. - Tr. Gravel - Sd. well graded. Dark yellowish Orange (10YR-6/6) to Light brown (5YR-5/6) - Sl. Damp
Box 3 of 3 18.2'-20'								19.0		18.2-20.0' - Top of Bedrock - Silty Claystone - Heavily oxidized in top 2" of core (FeOx - Dark yellowish Orange 10YR-6/6) - Rest is Pale yellowish brown (10YR-6/2) smeared with
								20.0 TD.		Grayish orange (10YR-7/4) streaks - Rain posited along side of core - (Badly distorted core) Bottom of interval consist of claystone chips - indurated & broken

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

4564

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: Z1198
Location - North: ______ East: ______
Date: 7/21/98
Geologist: ~~R. KOEHLER~~ (ON?) J. Boylan
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation: ______
Area: NORTH - PA
Total Depth: 29.5'
Company: TIERRA
Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR APPROVAL [signature] DATE 9-7-99

TOP/BOTTOM OF CORE BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
0.0 BOX 1 OF 7 0.0'-9.8'	0.0 RUN 1: 0.0-4.0	0.0 2.8					SM/SC	0.0–2.8		silty sand to sand-clay mixture w/silt — dark brown (10YR 4/3, 3/3) to dark yellowish brown (10YR 4/4). Dry to sl. moist. Natural horizontal partings (may relate to frequency of hammer blows). Rooted in top 0.5'. Scattered traces gravel, typically fine grained, w/gravel lens (w/gravels to >1") at 1.3-1.4'. Dark splotches (black; organic debris?) w/Fe-oxide pockets common @ 2.3-2.8'. Finer (more SC than SM) below 1.4'.
								2.8–4.0		NO RECOVERY 2.8-4.0
	4.0 / 4.0 RUN 2: 4.0-8.0	4.0 / 4.0 4.0 incl. 0.4' slough overpacked so despite the math recovery probably ~100%					SC	4.0–5.5		Same as above but lacking the coarser silty sand material. Gradual bottom contact. Dark yellowish brown (10YR 4/4) to dk. brown (10YR 4/3). Sl. moist. Fe-oxide-stained areas, stringers common. Caliche stringers also scattered. Fines to silt-clay mixture w/depth.
							CL	5.5–7.6		Silty clay — dark brown (7.5YR 4/3). Sl. moist to moist. Trace v.f.g. sand. Rare gravel clasts typically <½" diam. Occasional black carbonaceous flecks & pockets of Fe-staining.
								7.6–8.0		NO RECOVERY 7.6-8.0 (Note: because the 4.0' sleeve liner was overpacked and incl. some slough, actual recovery might have been 100%.)
9.8 / 9.8	8.0 / 8.0 RUN 3: 8.0-11.0	8.0 / 8.0 4.0' incl. 0.8' slough						8.0–10.0		Same as above, 5.5-7.6'. Moist.

NOTES: General: USCS is modified for this log as follows:
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(1) Badly broken core, accurate footage measurements not possible.
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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: 21198
Location - North: East:
Date: 7/21/98
Geologist: ~~R. KOEHLER~~ J. BOYLAN
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation:
Area: NORTH - PA
Total Depth: 29.5'
Company: TIERRA Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR APPROVAL [signature] DATE 9-7-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAINSIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
9.8	see previous page						CL	10.0		Same as above 5.5-7.6'.
	11.0 / 11.0 RUN 4: 11.0-14.0	11.0 / 11.0 4.0 incl. 0.8 slough						11.0		Same as above 5.5-7.6'. Moist. Increased gravel content — still trace, but coarser (to >1" diam.) not as rare.
BOX 2 OF 4 : 9.8' - 17.0'								12.0		
								13.0		
	14.0 / 14.0 RUN 5: 14.0-17.0	14.0 / 14.0 3.9' incl. 1.0' slough						14.0		Same as above 11.0-14.0'. Below 15.3', increased sand, gravel, with ~~color~~ change to strong brown (7.5YR 4/6). ~~below~~ Almost to SC, but clay still dominates. Transitional to SC below ~16.2', and some pockets to GC.
								15.0		
							SC	16.0 / 16.2		Clayey sand to sand-clay mixture w/ trace to some gravel — same as above 15.3-16.2', only coarser. Moist. Strong brown (7.5YR 4/6).
17.0 / 17.0	17.0 / ~~16.9~~ 17.0 RUN 6: 17.0-20.0	17.0 / ~~16.9~~ 17.0 4.0' incl. 1.0' slough						16.9 / 17.0		NO RECOVERY 16.9-17.0'
BOX 3 OF 4 17.0'-23'								18.0		Same as above 16.2-16.9'. Occasional pockets of clay-rich material (CL) as at 18.1-18.4', 18.8'-19.0'. Not homogeneous. Moist. Mottled colors, especially @ clay zones; dominantly dark yellowish brown (10YR 4/4) to strong brown (7.5YR 4/6). Scattered gravels to ~1", but typically ~½".
								19.0		
								20.0		

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 3 OF 3

Borehole Number: 21198
Location - North: ______ East: ______
Date: 7/21/98
Geologist: R. KOEHLER - J. BOYLAN / F. Grigsby
Drilling Equip.: GEOPROBE / MACROCORE
Surface Elevation: ______
Area: NORTH - PA
Total Depth: 29.5'
Company: TIERRA Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
17.0; Box 3 of 4 17.0 - 23.0	20.0; RUN 7: 20.0-23.0; 23.0	20.0; 4.0 incl. 1.0' slough; 23.0					SC	20.0 – 23.0		Same as above 17.0-20.0'. Similar mottling, clay pockets, gravel content, w/ some zones to CL, some to GC - but overall, SC.
	23.0; Run 8 23.0-25.0; 25.0	23.0; Recovered 0.7' core					CL	23.0 – 25.0		23.0 - 23.7 - Gravelly Clay - Some to abundant Sand - light gray (5YR 7/1) - some Strong Brown (7.5YR 5/8) sandy intervals - Core friable - Wet - WX. 23.7 - 25.0 - No Recovery
Box 4 of 4 23.0 - 29.5	Run 9 25.0 - 28.0; 28.0	Recovered 2.2' slough 0.6' core					GC	25.0 – 28.0		25.0 - 25.6 Clayey gravel - Some to abundant Sand - ~~Friable~~ Light Olive Gray (5Y 6/1) with some Light Brownish Gray (5YR 6/1) mottling - Core Wet - Clay Sticky & Plastic - Core becomes more Sandy & friable with depth - Int. WX. Some interm-xed claystn. frag. 25.6 - 28.0 - No Recovery *
	Run 10 28.0 - 29.5; 29.5	Rec. 2.3 slough 0.6' core					TD	28.0 – 30.0		28.0 - 28.6. - Claystone - Top of bedrock. - Dark Yellowish Brown (10YR 4/2) with Moderate Yellowish Brown (10YR 5/4) - Core sl. damp - Slough Above is Wet, Core mod. indurated. Depth Could be deeper - hole open to TD when setting Well Casing. 28.6 - 29.5 - No Recovery

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* - Abundant wet sandy Clay Slough above 28.0'

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: 21298
Location - North: ______ East: ______
Date: 08-19-98
Geologist: F. Grigsby - Rig&Log
Drilling Equip.: Geoprobe
Surface Elevation: ______
Area: ______
Total Depth: 20.5'
Company: Tierra
Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 - 8.0 - 9.4' of 3	Run No. 1 - 0.0 - 4.0'	Rec. 2.9'						0		0 - 1.1 - No sample - Fill - dug out for flush mount
								1		1.1 - 3.9' - Gravelly clay - some sd. - Pred. mod. yellowish brown (10YR-5/4) Core ~~wt~~ wx - dry - dense - Horizontal induced fractures. Some FeO staining.
							CL	2		
								3		3.4 - 4.0' - Probably recovered in run No. 2
	Run No. 2 4.0 - 8.0'	Rec. 4.0'						4		4.0 - 7.0 - Sandy Clay - Some silt - Moderate Brown (5YR-4/4) Core slightly damp - friable. - Sand varies to very sandy to mod. sandy - becomes clayer in lower 0.2' of interval.
								5		
							CL	6		
								7		7.0 - 8.0' Sandy Gravel - some clay - Color Pred. light Brown (5YR 5/6) core sl. damp, friable. - Gravel to broken cobbles to small (well graded) - Quartzite & granite fragments.
							GM			
	Run No. 3 8.0 - 11.0'	Rec. 3.5' (0.5' slough)						8		8.0 - 11.0 - Same as 7.0 - 8.0 - Sandy Gravel
Box 2							GM	9		
								10		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21298
Location - North: ________ East: ________
Date: 08-19-98
Geologist: F. Grigsby - Rig & Log
Drilling Equip.: Geoprobe

Surface Elevation: ________
Area: ________
Total Depth: 20.5
Company: Tierra Project No.: ________
Sample Type: Continuous Core.

EG&G LOGGING SUPERVISOR
APPROVAL ________ DATE ________

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 9.4' - 17.0'	Run No. 3						GM	10		
	Run No. 4 11.0'-14.0'	Rec. 4.0' (Slough in hole)					CL	11, 12		11.0'-13.1' - Sandy clay - some Gravel - Moderate Brown (5YR-4/4) in sandier intervals, Moderate Yellowish Brown (10YR 5/4) in clayey intervals. - (12.4'-13.1'). Core damp - friable to sticky & pliable. - Some scattered large gravel.
							SC	13		13.1-14.0' - Clayey Sand - some gravel - Moderate Brown (5YR-4/4) damp - friable to pliable -
	Run No. 5 14.0'-17.0'	Rec. 3.4'					SC	14		14.0-14.8' - Clayey Sd. - Same as 13.1-14.0 - Wet
							SM	15, 16		14.8-16.6 - Sandy Gravel - Light Brown (5YR-6/4) to Light Brown (5YR-5/6) - Large Gravel throughout. Heavily oxidized zone - yellowish red (5YR-5/8) in lower 0-2" of interval. - Core Saturated. ~~14.8-17.0' Gravelly sd. - Some clay Fe ... Light Brown (5YR-6/4)~~ Fe
Box 3 of 3 17.0'-20.5'	Run No. 6 17.0'-20.0'	Rec. 3.3'					CL	17		16.6'-18.1' Sandy Clay - Some Gravel - Damp pliable - Pale Yellowish Brown (10YR-6/2) -
							SC	18, 19		18.1'-19.2' - Clayey Sd. - ~~To~~ Small Gravel. - Lt Brown (5YR-5/6). Wet - Sd. - well graded - fine to coarse. - Qtz & Feldspar (Pred.)
								20		TOP OF Bedrock 19.2'-21.0' - Claystone - Pale yellowish Brown (10YR 6/2) Some grayish Orange (10YR 7/4) Fe staining - Abundant MnO Staining

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Easily broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE BOREHOLE LOG

Borehole Number: 21298

Location - North: ______ East: ______

Date: 02-25-99

Geologist: F. Grigsby

Drilling Equip.: ______

Surface Elevation: ______

Area: ______

Total Depth: 20.5'

Company: Terra

Project No.: ______

Sample Type: Continuous Core

RMRS LOGGING SUPERVISOR APPROVAL ______ DATE ______

TOP-BOTTOM OF CORE IN BOX	TOP-BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 3	Cleaning Runs to clean hole							20		
								20.5		
								21	TD	Two cleaning runs to clean hole., Rec. 6" Bedrock (20-20.5 & 20.5-21.0) with each run. - Well Completed at 20.0' with slough from 20.0' to 21.0'

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

Procedure No. RMRS/OPS-PRO.101
Revision 0
Date effective: 12/31/98

4011-930-0134-930X Form GT (A X0501.N2)

~~445~~ 462

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 21398
Location - North: East:
Date: 08-25-98
Geologist: F. Grigsby, Rig & Log
Drilling Equip.: Geo Probe

Surface Elevation:
Area: N. PA Plume
Total Depth: 16.0'
Company: Tierra Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 2 0.0' - 9.9'	Run No. 1 0.0'-4.0'	Rec. 2.3'					ML	0		0.0' - 0.2 - Clayey Silt - Topsoil Dark Yellowish Brown (10YR-4/2) Dry - friable - roots & grass.
							GC	1		0.2 - 2.3 Sandy Gravel - some clay - Pinkish Gray (5YR-8/1) with spotty Dark Yellowish Brown (10YR-4/2) and Dark yellowish orange (10YR-6/6) sediments. - Gravel Pred. large - some broken cobbles Pred. quartzite - Core dry - friable.
								2		
								3		2.3-4.0' - No Recovery
							GC	4		4.0' - 4.5' - Sandy Gravel - same as 0.2 - 2.3' Abrupt color change to Moderate Brown (5YR-4/4) at 4.3 to 4.5' with some intermixed yellowish gray (5Y-7/2) clay streaks. Very strongly oxidized layer of Moderate reddish Brown (~~10YR~~ 10R 4/6) at contact with underlying sediments.
	Run No. 2 4.0'-8.0'	Rec. 4.0'						5		
							Cl	6		4.5-8.0' Clay - Some Gravel & silt Tr. sd. Brownish Black (5YR-2/1) large gravel spread throughout interval. Numerous roots at top of interval with some throughout entire interval - (old soil horizon covered with fill) Estimated med. plasticity - Dry & dense.
								7		
	Run No. 3 8.0'-12.0'	Rec. 3.4'						8		8.0'-10.3' - Sandy Clay - some gravel - Dark yellowish brown (10YR-4/2) to approx 9.3' - Color change to Moderate Yellowish Brown (10YR-5/4) to 9.9'-10.3' - Ss clast at 9-9.2' ± - Core mod. friable - Very sl. damp. -
							CL.	9		
								10		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21398
Location - North: ______ East: ______
Date: 02-25-98
Geologist: E. Grigsby - Rig 8209
Drilling Equip.: Geoprobe

Surface Elevation: ______
Area: ______
Total Depth: 16.0'
Company: Tierra Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 2 9.9 - 16.0	Run No 3 8.0-11.0	Rec 3.4					CL	10		10.3'-13.1 - Clay - some sd. Tr. gravel - Color grades from yellowish gray (5Y-7/2) to moderate yellowish brown (10YR-5/4) with some Dark yellowish orange (10YR 6/6) streaks in upper half of interval. - Est. med. plasticity, wx. some sts. sl. damp. - Stiff - dense. - some gravel at contact with underlying bedrock.
	Run No 4. 11.0'-14.0'	Rec. 4.0'					CL	11, 12, 13		
	Run No. 5 14.0'-16.0'	Rec. 2.2'						14, 15, 16	TD.	13.1-16.0 - Top of bedrock Claystone - grades from light olive gray (5Y-6/1) to brownish gray (5YR-4/1) to pale yellowish brown (10YR-6/2) at bottom of interval. Upper contact heavily oxidized (1/2" ±) (Dark yellowish orange 10YR-6/6) Core sl. damp. - Mod. indurated. Mod. to heavily disturbed or brecciated

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 21498
Location - North: East:
Date: 8-20-98 / 8-24-98
Geologist: T. LUTHERER, F. Grigsby
Drilling Equip.: GEOPROBE
Surface Elevation:
Area: PA
Total Depth: 15.0'
Company: TIERRA
Project No.:
Sample Type: CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
	RUN 1 0-1.0	REC 1.0						0		0-1.0 Clayey Silty Sand, Mod. Brown to Pale Yellowish Brown (5YR 3/4 to 10YR 6/2) pred very fine to fine, trace gravel, trace roots, locally very silty, locally damp.
	RUN 2 1.0-5.0	REC 4.0					CL	1–5		Sandy Silty Clay Mod. Brown (5YR 4/4) Sand A/A, trace broken lithic gravel, damp, locally moist. Sand, Mod Brown (5YR 4/4) pred fine to med, some coarse, some to mod Clay, silty A/A, moist. Clay Mod Brown (5YR 4/4) with traces sand + broken lithic gravel A/A damp.
Box 1 of 3 0.0-9.0	Run No. 3 5.0-9.0	Rec. 4.0					CL	5–9		5.0'-9.0' - Gravelly Clay - Some sd. Dark yellowish Brown (10YR 4/2) grading to Moderate yellowish Brown (10YR 5/4) in top foot of interval. Some spotty Grayish orange (10YR 7/4) FeO staining - clay is damp - very sticky - increased plasticity. Some interbedded clay zones.
Box 2 ...	RUN No. 4 9.0-...	Rec. ...					CL	9–10		9.0'-9.9' - Gravelly Clay Moderate Yellowish Brown (10YR 5/4) at top of interval - Medium Gray (N5) at Bottom of interval.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21498
Location - North: ______ East: ______
Date: 08-24-98
Geologist: E Grigsby
Drilling Equip.: Geoprobe
Surface Elevation: ______
Area: N-PA Plume
Total Depth: 15.0'
Company: Terra
Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 9.0'-13.0'	Run No. 7 9.0'-12.0'	Rec. 3.0'						10		9.0-9.9' - Cont. Clay changes from stiff clay to mod. indurated. - large gravel clast at contact of bedrock.
								11		9.9'-13.0' - Top of Bedrock - Claystone - mottled appearance - Color intermixed moderate yellowish brown (10YR 5/4) and Pale yellowish brown (10YR-6/2). Core appears very reworked - some carbonaceous material, some MnO, and abundant FeO staining. - Core mod indurated
	Run No. 8 12.0'-13.0'	Rec. 2.6' Slough in hole						12		
Box 3 of 3 13.0'-15.0'	Run No. 9 13.0'-15.0'	Rec. 3.6' Slough in hole						13		
								14		13.0-15.0' - Claystone Mod. Yellowish Brown (10YR 5/4) at top of interval - grading to fred - Pale Yellowish Brown (10YR-6/2) in lower 2/3 of interval. Top 6" from 13.2'-13.4' well oxidized interval (Dark yellowish orange - 10YR-6/6 with ironstone nodules - Possibly some fractures. - Core showed drilling induced fractures when removed from tube. Accounts for excess recovery in interval below Slough. - Core dry, Mod. indurated. Measured TD = 15.0'
								15		
								16		
								17		
								18		
								19		
								20		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21598
Location - North: ______ East: ______
Date: 08-26-98
Geologist: E. Grigsby, R. Selos
Drilling Equip.: Geoprobe

Surface Elevation: ______
Area: N. PA. Plume
Total Depth: 15.0'
Company: Tierra Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

Box / Run / Recovery	USCS Symbol	Depth in Feet	Sample Description
Run No. 1 0.0'-2.9' Rec. 2.9'	CH	0–2	0-2.1 - Gravelly Clay, some sd. and silt, Pale yellowish Brown (10YR 6/2) grading to Moderate Brown (5YR 3/4) - Gravel Pred. Med. Size Quartzite. Core very sl. damp. Mod. friable - wx.
	CL	2–2.9	2.1-2.9 Silty Clay - some sd. - Grayish Brown (5YR 3/2) at top - Dark yellowish Brown at Bottom (10YR 4/2) - Mod friable very sl. damp - wx.
		2.9–4	2.9-4.0 - No ~~Rec.~~ Recovery
Box 1 of 2 0.0'-8.5' Run No. 2 4.0'-7.0' Rec. 3.0'	CL	4–4.5	4.0'-4.5' - Clay - some sd. & silt - Dark yellowish Brown (10YR 4/2) - Very sl. damp - friable
	GC	4.5–6.6	4.5-6.6 - Clayey Gravel - some sd. Dark yellowish Brown (10YR 4/2) grading to moderate yellowish Brown (10YR 5/4) very sl. damp, Non friable - wx - Gravel from broken Cobbles to small - some clayey zones
	SC	6.6–7.0	6.6-7.0 - Clayey Sd. - Tr. gravel Brown (7.5YR 5/4) - mod. friable - ox (wx) very sl. damp
Run No. 3 7.0'-10.0' Rec. 4.0' Slough in hole; Box 2 of 2	CL	7.0–10	7.0'-11.7 Clay - Brownish Gray (5YR 4/1) - Composed of predominately reworked (recemented clay) Bedrock Claystone fragments - Very sl. damp - Pliable to sticky - some spotty Carbonaceous material & some spotty FeO stained material. Difficult to determine accurate ~~accurate footage because of the~~

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21598
Location - North: ______ East: ______
Date: 08-26-98
Geologist: F. Grigsby, Rig Log
Drilling Equip.: Geoprobe
Surface Elevation: ______
Area: ______
Total Depth: 15.0'
Company: Tierra
Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

Box / Run / Recovery	USCS	Depth in Feet	SAMPLE DESCRIPTION
Run No. 4, 10.0-13.0', Rec. 2.0 (Estimated)	CL	10–13	7.0-11.7' Continued footage depths because of slough composed of this material. 11.7-13.0' - Clay - same as above except very oxidized color. Moderate yellowish brown (10YR-5/4) - composed ~~predominantly~~ predominately of bedrock fragments recemented with clay - some moisture when retrieved from core sleeve. -
Box 2 of 2, 8.0'-15.0'; Run No. 5, 13.0-15.0', Rec. 2.2'		13–15	13.0'-15.0' - Top of bedrock - claystone - grayish orange (10YR-7/4) and pale yellowish brown (10YR-6/2) at top grading to pale yellowish brown (10YR-6/2) at bottom. Mod. abundant to abundant dark yellowish orange (10YR-6/6) Fe staining throughout interval - Entire interval appears to be reworked ~~cl...~~ No apparent well defined fractures or bedding.
		15 TD	

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: BH21698
Location - North: East:
Date: 08/27/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE/MACROCORE
Surface Elevation:
Area: NORTH - PA
Total Depth: 20.0 ft
Company: TIERRA
Project No.:
Sample Type: PUSH/ CONTINUOUS CORE

EG&G LOGGING SUPERVISOR APPROVAL [signature] DATE 9-7-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION Clayey Gravel - some sd.
Box 1 of 4 0.0 to 8.3 ft.	Run #1 0.0-3.5 ft.	Recovery 3.5 ft.					GC	0.0 – 3.3		0.0-3.3 ft; ~~clay/sand/gravel~~; yellowish brown (10YR 5/6) with occasional mottling ~~with~~ of light olive gray (5Y 6/2); subround to round gravel up to 2.5 cm, some pieces fractured by coring, quartzite in part; fine quartz sand; pinpoint patches of caliche; firm; slightly plastic; slightly moist. subangular to subround, poorly sorted, quartz and igneous rock frags, hard, dry, pulverized by coring. pink matrix - clayey.
	3.5						SC	3.3 – 3.5		3.3-3.5 Sand; pale red (10R 6/4); medium to coarse
	Run #2 3.5-3.8	Recovery 0.3					SC	3.5 – 3.8		3.5-3.8 Sand as above 3.3-3.5
	3.8 Run #3 Pre-Probe	No Core Taken						3.8 – 4.6		Pre-probe with 1.5 inch solid point to get through hard zone.
	4.6						SC	4.6 – 5.0		4.6-5.0 Sand as above 3.3-3.5 ft.
	Run #4 4.6-7.0 ft.	Recovery 2.5 ft. (Hand hammering 3.8-4.3 ft)					SC	5.0 – 6.0		5.0-6.0 Clayey Sand; mottled pale red (10R 6/4) to yellowish brown (10YR 5/8); medium to coarse grained quartz and igneous rock frags, qtz is rounded and frosted, clay content variable, clayey parts plastic, gravel lag at bottom, moist.
							CL	6.0 – 7.0		6.0-7.0 Clay; mottled yellowish brown (10YR 5/6) to light gray (10YR 7/1), firm, plastic, slightly moist, possibly caliche patches, carbonaceous patches.
8.3 Box 2 of 4 8.3-	7.0 Run #5 7.0-10.0 ft.	Recovery 4.0 ft including 1.0 ft of slough					CL	7.0 – 10.0 (8.3)		7.0-10.0 Clay as above 6.0-7.0 ft. More gray than brown. Occasional small rock chip (<0.5 cm) Looks like it could be made of clay clasts. Root hairs to at least 8.3 ft. Still carbonaceous. Some FeO staining - Dark Yellowish orange (10YR 6/6)

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: BH21698
Location - North: East:
Date: 8/27/99
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation:
Area: NORTH-PA
Total Depth: 20.0 ft
Company: TERRA Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR APPROVAL [signature] DATE 9-7-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 4 8.3–13.7 ft.	Run #6 10.0–12.0 ft.	Recovery 4.0 ft including 1.0 ft slough					CL	10.0 – 11.0 – 11.5		10.0–11.5 ft. Clay as above 6.0–7.0 and 7.0–10.0 More yellowish brown material (FeO) No Root Hairs Less Carbonaceous
							SC	11.5 – 12.0		11.5–12.0 ft; Clayey Sand; yellowish brown (10YR 5/8) to light olive gray (5/6/2), fine quartz sand, well sorted, firm, 2 pieces of gravel (5 mm), ~~calcite vein fill~~, moist
	12.0 Run #7 12.0–14.0 ft.	Recovery 4.0 ft including 1.1 ft slough				12.7	SC	12.0 – ~~12.7~~		12.0–12.7 Clayey sand; as above 11.5–12.0 calcite(?) vein fill near bottom.
13.7							CL	13.0 – 13.7 – 14.0		12.7–14.0; Clay; yellowish brown (10YR 5/8) to gray (2.5Y N6), crumbly, firm, only slightly plastic, slightly moist, some conchoidal fractures root hair at 13.0 ft,
Box 3 of 4 13.7–18.0 ft.	14.0 Run #8 14.0–16.0 ft	Recovery 4.0 ft including 0.8 ft slough					CL	14.0 – 15.0 – 16.0		14.0–16.0; Clay; as above 12.7–14.0 ft More crumbly and fractured, almost dry, hard, not plastic. ← 14.9–15.1 fine sandy zone. Bedrock contact approximately 13–15 ft.*
18.0	16.0 Run #9 16.0–18.0 ft	Recovery 4.0 ft including 0.3 ft slough					CL	16.0 – 17.0 – 18.0		16.0–18.0, Clay, as above 12.7–14.0 and 14.0–16.0. Even more crumbly and fractured, almost dry hard, not plastic. Mostly grayish brown (2.5Y 5/2) some oxidation stains (16.0–17.0 ft)
Box 4 of 4 18.0–20.0 ft.	Run #10 18.0–20.0 ft.	Recovery 4.0 ft including 1.1 ft slough					CL	18.0 – 19.0 – 20.0		18.0–20.0 ft. Clay, as above 16–18.0 ft.

20.0

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* – Entire interval extensively reworked. No definite Bedrock Pick F.G.

#7470

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: BH21798
Location - North: ______ East: ______
Date: 08/31/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation: ______
Area: NORTH - PA
Total Depth: 26.0ft.
Company: TIERRA
Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL: Fred Grigsby
DATE: 9-7-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
NoT Saved	1.1							0.0 – 1.1		0.0 to 1.1 Excavated to install flush mount well casing. Material not saved. Material dug out similar to material 1.1 to 3.1 ft.
Box 1 of 3; 1.0 to 11.5 ft.	Run #1 1.1 to 5.0 ft.	Recovery 2.0 ft.					GC	1.1 – 3.1		1.1 to 3.1 ft; ~~Clay, Sand, Gravel~~ Clayey Gravel, some sd. FG 9/7/99
								3.1 – 5.0		No Recovery 3.1 to 5.0 ft. dark brown (7.5YR 4/4); quartzite gravel up ~3 cm, mostly fractured, angular, well graded but poorly sorted, not plastic, barely mois[t]
	5.0 Run #2 5.0 to 8.0 ft.	Recovery 3.5 ft. No obvious slough					GC	5.0 – 8.0		5.0 to 8.0 ft. ~~Clay, Sand, Gravel~~ Clayey Gravel as above 1.1 to 3.1 ft. FG 9/7/99. Compact more ~~clay~~ sandy clay intervals 7.0 to 7.2 and 7.5 to 7.8 ft. FG 9-7-99
	8.0 Run #3 8.0 to 11.0 ft. 10.0	Recovery 2.0 ft. No obvious slough					GC	8.0 – 10.0		8.0 to 10.0 ft; ~~Clay, Sand, Gravel~~ Clayey Gravel - some sd. as above 1.1 to 3.1 ft. FG 9-7-99

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: BH21798
Surface Elevation:
Location - North: East:
Area: NORTH-PA
Date: 08/31/98
Total Depth: 26.0 ft
Geologist: R. KOEHLER
Company: TIERRA
Project No.:
Drilling Equip.: GEOPROBE / MACROCORE
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred Grigsby
DATE 9-7-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
1.0-11.8 RPK 8/31 Box 1 of 1 2 to 11.8	Run #3 8.0-11.0 ft	Recovery 2.0 ft No depth					GC	10.0		10.0-11.0 ft. No Recovery
							GC	11.0 – 11.8		Clayey Gravel - some sd 11.0-11.8 ~~Clay Sand Gravel~~ As above 1.1-3.1 ft FG 9/7/99
Box 2 of 3 11.8 to 20.0 ft.	Run # 4 11.0-15.0 ft	Recovery 1.4 ft.					GC	12.0 – 12.4		FG 9/7/99 Clayey Gravel - some sd. sand 11.8-12.4 ~~Clay Gravel~~, Top 0.5 ft olive (5Y 5/3), 1.5 black (5Y 2.5/2), rounded gravel up to 2.5 cm, ~~~~ sand, well graded poorly sorted, firm, stiff, plastic, moist, fine abrupt color change/contact, root hairs in black material
							GC	13.0		No Recovery 12.4 to 14.0 ft
	Run # 5 14.0-17.0 ft.	Recovery 4.0 ft.		change to CL symbol			CL FG ~~GC~~	14.0 – 16.0		Sandy Clay - some Gravel 14.0-17.0; ~~Clay, Sand, Gravel~~ gravel ~~As above 11.8-12.0~~ FG. olive to dark olive gray (5Y 4/2 to 5Y 3/2), rounded gray gravel to 2 cm, quartzite, fine sand, well graded poorly sorted, soft, plastic, moist, Gravel mostly quartzite but also feldspathic igneous rock fragments, sand is similar. One light olive gray patch at 15 ft (5Y 6/2)
	Run #6 17.0-20.0 ft.	Recovery 3.5 ft No depth 3 long		change to Clstn			CL FG ~~GC~~	17.0 – 18.0		FG 9/7/99 Sandy Clay - some Gravel 17.0-18.9 ~~Clay, Sand, Gravel~~ as above 14.0-17.0 Much less gravel, More sand than clay? moist, soft, plastic.
							omit ~~SC~~	18.9 – 20.0		Loss at bottom ~~sandy~~ ~~FG~~ clay stn. Top of Bedrock FG 9/7/99 18.9-20.0 ~~Sandy Clay~~ light gray (2.5Y N6) with patches and gm carso to olive yellow (2.5Y 6/8), fine sand, soft, plastic, moist, limonitic nodules, caliche in pinpoints ss stn.

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(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 3 OF 3

Borehole Number: BH21798
Location - North: East:
Date: 08/31/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation:
Area: NORTH - PA
Total Depth: 26.0 ft
Company: TIERRA
Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR APPROVAL: Fred Griggs DATE 9-7-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 3 of 3 20.0-26.0 ft.	Run #7 20.0-23.0 ft.	Recovery 3.7 ft including ~~1.5~~ 0.8 ft of wet soupy slough	Changed symbol to claystn		omit		~~SC~~	20.0 – 21.7		20.0-21.7 Sandy ~~Clay~~ claystn FG as above 18.9-20.0 Less caliche (most near base at 21.1 to 21.2) Sandy zones in bottom 1 ft.
					omit		CL	21.7 – 22.9		21.7-22.9 ~~Clay~~ claystn, Gray (7.5YR N6-N5) with strong brown streaks (7.5YR 5/6-5/8), may be made of clay clasts, soft plastic to blocky fracture, carbonaceous, moist.
								22.9 – 23.0		~~NO Recovery 22.9 - 23.0~~ , Sandy Claystn -
	Run #8 23.0-26.0 ft.	Recovery 3.5 ft including 0.5 ft slough (may be more slough?)			omit		SC	23.0 – 24.0		23.0-24.0 ~~Clayey Gravel and~~ ? (May just be slough) light olive gray (5Y 6/2), fine sand, soupy in part, plastic, wet.
					omit		CL	24.0 – 26.0		claystn (Bedrock contact? 24.0 ft) see NOTE 24.0-26.0 ~~Clay~~, olive brown (2.5Y 4/3) to gray (2.5Y 5/1), with strong brown stains on fractures (7.5YR 5/8), slightly plastic, firm to hard, fractures with limonite staining, some sand (along fractures?) fractures horizontal, slightly moist.

TD = 26.0 ft.

Bedrock contact about 24.0 ft.
changed to 18.9' - FG

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A (REV. 2)

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: 21898
Location - North: East:
Date: 9-8-98
Geologist: E. Grigsby, Rig & Log
Drilling Equip.: Geoprobe

Surface Elevation:
Area: North PA Plume
Total Depth: 22'
Company: Tierra
Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR APPROVAL ______ DATE ______

Run / Core	Rec.	USCS	Depth in Feet	SAMPLE DESCRIPTION
			0	0.0'-1.0' - No Sample - Dug out Gravel, cobbles and clay
Run No. 1, 1.0-4.0	Rec. 2.4'	GC	1–3	1.0-3.4' - Clayey Gravel - Some silt. Matrix Pred. Pale yellowish Brown (10YR-6/2) with Some Moderate yellowish Brown (10YR-5/4) core dry, Mod. friable - est. Low Plasticity. - wk
			3	3.4'-4.0' - No Rec.
Run No. 2, 4.0-8.0	Rec. 2.4'	GC	4	4.0'-5.2' - Clayey Gravel - Some silt, Same as 1.0-3.4'
		GC	5–6	5.2-6.4' - Clayey Gravel - Some Sd - Color Mod. Yellowish Brown (10YR-5/4) with Some Moderate Brown (5YR-4/4) & Mod. Brown (5YR-3/4) Clay Chunks - Core dry - Mod friable - Est. Plasticity low to Mod. - Some asphalt fragments at bottom of recovered core.
			7	6.4'-8.0' - No. Rec.
Run No. 3, 8.0'-12.0'	Rec. 3.1'	GC	8	8.0'-8.8' - Clayey Gravel - Some Sd - Same as 5.2'-6.4'
			9	8.8-9.0' EG - Broken Cobble
		Cl	9–10	9.0'-11.1' - Silty Clay - Some gravel. Dark Yellowish Brown (10YR-4/2) to Mod. Yellowish Brown (10YR-5/4) with Some Spotty Dusky Yellowish Brown (10YR-2/2)

NOTES: General: USCS is modified for this log as follows:
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(2) Core breaks cannot be matched, accurate footage measurements not possible.

401-##-50-01 (04-90) Form GT.1A (03/01/90)

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21898
Location - North: East:
Date: 9-8-98
Geologist: F. Grigsby, Rig & Log
Drilling Equip.: Geoprobe
Surface Elevation:
Area: N-PA Rome
Total Depth: 22'
Company: Tierra
Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL
DATE

BOTTOM OF CORE BOX	BOTTOM OF INTERVAL FEET OF CORE RECOVERED (FIELD MEASUREMENT)	SAMPLE NUMBER	TIME	DEPTH	USCS SYMBOL	DEPTH FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 6, 0.0'-12'	Run No. 3, 8.0'-12.0', Rec. 3.1'				CL	10		9.0'-11.1' - continued. Est. Med. plasticity, Nonfriable Dense - Dry. - Wx. Gravel blocking cutting shoe
						11		11.1-12.0' - No Recovery
Box 2 of 6, 12'-19.3'	Run No. 4, 12.0'-16.0', Rec 4.0', Includes 0.7' of slough					12		12.0'-15.4' - Silty Clay - Trace to some gravel - Top 0.1' of interval same as 9.0'-11.1'. Clay becomes
					CL	13		Dusky Yellowish Brown (10YR-4/2) Grading to Moderate Yellowish Brown (10YR-5/4). Very slightly damp - Nonfriable. Some root hairs in upper half of interval - Wx.
						14		
						15		15.4'-16.0' - No Recovery ~~15.4-16.0 - No Recovery~~ FG. ~~15.9-15.9' - Silty clay same as 12.0-15.4 except less compacted~~ FG
	Run No. 5, 16.0'-19.0', Rec. 3.7' (Rec. Core from previous run)					16		16.0-16.6' - Sandy Clay - Some gravel - Mod. Yellowish Brown (10YR-5/4) - dry - mod. friable
					CL	17		16.6-~~17.9~~ 18.3' Silty Clay - Trace gravel Mod. Yellowish Brown (10YR-5/4) Trace fragments of claystone -
						18		18.3'-22.0' Claystone: some silt. Top of Bedrock ~~17.9-19.0 clayey sd. some fn gravel~~ FG. Pale Yellowish Brown
Box 3 of 3	Run No. 6, 19.0'-22.0'					19		with abundant Dark Yellowish Orange (10YR-6/6) FeO stained zones. - Entire Interval
						20		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 21898
Location - North: ______ East: ______
Date: 9-8-98
Geologist: E. Grigsby - Rig 8 Log
Drilling Equip.: Geoprobe
Surface Elevation: ______
Area: N. PA. Plume
Total Depth: 22'
Company: Tierra
Project No.: ______
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
BSX 13-83 19.4'-22.0'	RUN No. 6 19.0'-22.0	Rec. 4.0 0.1' slough						20		18.3'-22.0' continued Very reworked. Did not reach undisturbed bedrock. - Core dry - Non friable to sl. friable. Some fine calcite filled fractures
								21		
								22	TD	

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
1) Badly broken core, accurate footage measurements not possible.
2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: BH 21998
Location - North: East:
Date: 09/01/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE

Surface Elevation:
Area: NORTH - PA
Total Depth: 20.0
Company: TIERRA
Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred Grigsby DATE 9-8-99

Top/Bottom of Interval	Feet of Core in Interval (Field Measurement)	Sample Number	Fracture Angle	Bedding Angle	Grain Size Distribution	USCS Symbol	Depth in Feet	Sample Description
							0.0 – 1.0	No Core 0.0–1.0. Dug away to make hole for flush mount housing. No Recovery
Run #1 1.0 - 5.0 ft	Recovery 3.7 ft					~~GM~~ GC	1.0 – 3.7	Clayey Gravel - some sd. 1.0-3.7; ~~Clay, sand,~~ Gravel; yellowish brown (10YR 5/6), Subround to fractured gravel up to 3.5 cm, quartzites, fine to coarse sand, Crumbly, not plastic, slightly moist. poorly sorted, well graded.
							3.7 – 5.0	No Recovery 3.7 - 5.0 ft.
Run #2 5.0 - 8.0 ft	Recovery 2.0 ft					GC	5.0 – 7.0	Clayey Gravel - some sd. 5.0-7.0 ft; ~~Clay, Sand, Gravel~~ as above 1.0 to 3.7 ft. Becomes more moist and plastic towards bottom of interval. Grayish green (10G 4/2) clay (nodule?) at 6.8 ft.
							7.0 – 8.0	No Recovery 7.0 - 8.0 ft.
Run #3 8.0 - 11.0 ft	Recovery 1.9 ft					GC	8.0 – 9.1	8.0-9.1, clay, Sand, Gravel as in 5.0-7.0 moist, plastic. Sand/Gravel lag (gravel <1.0 cm) Black (5Y 2.5/2)
Change to CL sym. – FG						~~CH~~ CL	9.1 – 9.9	9.1-9.9 Clay with clay nodules; olive gray (5Y 4/2) with patches of yellowish brown (10YR 5/6), clay nodules, dark gray (10YR 4/1), <5mm, plastic, moist, poorly sorted & graded
							9.9 – 10.0	No RECOVERY 9.9 - 11.0 ft.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: BH21998
Location - North: ______ East: ______
Date: 09/01/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE / MACROCORE
Surface Elevation: ______
Area: NORTH-PA
Total Depth: 20.0 ft.
Company: TIERRA
Project No.: ______
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR APPROVAL: Fred Grigsby DATE: 9-8-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
	Run #3 8.0-11.0 ft	Recovery 1.9 ft.						10.0 – 11.0		No Recovery 9.9 ft to 11.0 ft
water	Run # 4 11.0-14.0 ft	Recovery 1.9 ft including 0.3 ft of wet clayey sand slough		change to CL symbol		~~CH~~ CL		11.0 – 12.0 – 12.6		11.0-12.6 ft; Clay with nodules, occasional gravel with and without sand as marked; olive gray at top (5Y 4/2) grades down to yellowish brown (10YR 5/3); lower 0.2 ft dark olive gray (5Y 3/2), gravel rounded up to 2cm, sand and gravel discrete from clay, plastic, soft, moist to wet.
								13.0 – 14.0		No recovery 12.6-14.0 ft.
	Run # 5 14.0-17.0 ft	Recovery ~~2.1 ft~~ 1.8 ft (RPK) including ~~1.0~~ 0.4 ft wet sandy clayey sand slough		change to CL symbol		CL ~~FG CH~~		14.0 – 14.6		14.0-14.6 ~~Nodgy~~ sandy (FG) clay with gravel as above 11.0-12.6 ft. Wet sandy Gravelly clay FG 9-8-99
				change to CL symbol		~~CC~~ ~~SC~~ CL		14.6 – 15.0 – 15.8		14.6-15.8; ~~Clay, Sand, Gravel,~~ dark olive gray to black (5Y 3/2) to (5Y 2.5/2); rounded gravel (igneous rock fragments - feldspathic) up to 3.5 cm, fine sand, soft, plastic, massive, wet. May be old soil, trace root hairs.
								15.8 – 16.0 – 17.0		15.8-17.0 ft No Recovery.
	Run # 6 17.0-20.0 ft 3.3 RPK 9/1/98	Recovery ~~2.5 ft~~ including 0.8 ft wet sandy sand slough		change to CL symbol		CL FG ~~SC~~		17.0 – 18.0 – ~~18.7~~		17.0 – ~~18.5~~ ~~18.5~~ FG ~~9-8-99~~ Gravelly clay - some sd. ~~Clay, Sand, Gravel~~ as above, 14.6-15.8 light olive brown (2.5Y 5/3), fractured gravel dominant in 18.5 to 19.5 interval - 2.5→3.0 cm (feldspathic) soft, plastic, moist to wet. No obvious root hairs 18.5-19.5 - Clayey Gravel - some broken cobbles - some sd.
				change to GC symbol		GC		19.0 – 19.5		~~18.7-20.0 No Recovery~~ RPK 9/1/98
								19.5 – 20.0		19.5-20.0 No Recovery

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

T.D. = 20.0 ft. Not in Bedrock

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: B# 22098
Location - North: East:
Date: 09/02/98
Geologist: R. KOEHLER / J. Boylan
Drilling Equip.: GEOPROBE / MACROCORE
Surface Elevation:
Area: NORTH - PA
Total Depth:
Company: TIERRA Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Grigsby DATE 9-8-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 1	1.0							0.0		0.0-1.0 Flush mount well casing hole. No material cored or saved. NO RECOVERY. sandy Gravel - some clay FG 9-8-99
	Run #1 1.0-5.0 ft	Recovery 2.2 ft	change to GC symbol				GC FG SM / SC FG	1.0 - 2.0 - 3.0 - 3.2		1.0-3.2 ft: ~~Clay, Sand, Gravel~~, yellowish brown (10YR 5/3), Quartzite and Feldspathic gravel up to 2.5cm fractured, pieces < 2.0cm may be rounded, fine to coarse quartz and feldspathic sand, massive, soft, slightly plastic, moist, last 0.5 ft wet.
								4.0 - 5.0		3.2-5.0 No Recovery. sandy Gravel - more clay than above FG 9-8-99
	Run #2 5.0-9.0 ft	Recovery 1.8 ft	change to GC symbol				FG SM / SC FG GC	5.0 - 6.0 - 6.8		5.0-6.8 ft: ~~clay, sand, gravel~~ as above 1.0 to 3.2 ft. yellowish brown (10YR 5/3) at top grades to olive gray (5Y 4/2) at bottom, wet for most of sample except bottom 0.5 ft where it is just moist. Poured water (100ml) out of core liner
								7.0 - 8.0 - 9.0		6.8-9.0 No Recovery. sandy Clay - some silt & Gravel
	Run #3 9.0-13.0 ft	Recovery 3.1 ft incl. 0.4 ft slough	use CL				CL / SC	9.0 - 10.0		Sandy, silty clay w/gravel - predominantly light yellowish brown to light olive brown (2.5Y 6/3 - 2.5Y 5/3), mottled. Some zones sandier, some more clay-rich. Moist to wet. Gravels mainly quartzite.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: BH22098
Location - North: East:
Date:
Geologist: R. KOEHLER / J. Boylan
Drilling Equip.: GEOPROBE / MACROCORE
Surface Elevation:
Area: NORTH-PA
Total Depth: 31.0'
Company: TIERRA
Project No.:
Sample Type: PUSH / CONTINUOUS CORE

EG&G LOGGING SUPERVISOR APPROVAL Fred C. Grigsby DATE 9-8-99

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
	Run #3 9.0-13.0ft	Recovery 2.1ft including 0.4ft of slough		use CL			CL/SC	10.0		see previous page
								10.7, 11.0, 12.0		10.7-13.0ft No Recovery
										sandy clay - some gravel & SC
	13.0 RUN 4: 13.0-17.0	13.0 2.4 (incl. 0.9 slough)					CL	13.0, 14.0, 14.5		Same as above, 9.0-10.7, but not as sandy.
								15.0, 16.0		NO RECOVERY 14.5-17.0
										sandy clay - Tr gravel
	Run #5 17.0-21.0ft	Recovery 1.35ft including 0.5ft of sandy slough					CL	17.0, 17.95, 18.0		17.0-17.95ft clay with gravel - minor sand as above in color, then 0.1ft black (5Y 2.5/1) then very olive gray (5Y 4/2), rounded gravel to 0.5cm, quartz, plastic, moist, soft.
								19.0, 20.0		17.95-21.0 No Recovery

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 3 OF 3

Borehole Number: BH22098
Location - North: ______ East: ______
Date: 09/02/98
Geologist: R. KOEHLER
Drilling Equip.: GEOPROBE/MACROCORE

Surface Elevation: ______
Area: NORTH-PA
Total Depth: 31.0'
Company: TIERRA
Project No.: ______
Sample Type: PUSH/CONTINUOUS CORE

EG&G LOGGING SUPERVISOR
APPROVAL Fred C. Grigsby
DATE 9-8-99

Run / Interval	Recovery	Depth (feet)	Sample Description
Run #5 17.0-21.0	Recovery 1.2 inches, 0.8 slough	20 – 21.0	17.95-21.0 No Recovery
Run #6 21.0-25.0 ft	Recovery 0.3 ft of wet muddy sand probably all slough	21.0 – 21.3	21.0-21.3 wet muddy sand - slough?
		21.3 – 25.0	sandy clay - some gravel
Run #7 25.0-31.0 ft (over drilled / miscounted rods)	Recovery 4.0 ft	25.0 – 26.3	25.0-26.8 Clay sand gravel as above 17-17.9 ft. more than above - F.G.
		26.3	Top of Bedrock F.G. - Claystone silty F.G.
		26.3 – 29.0	26.3-29.0 ft, ~~clay~~, gray (5Y 6/1) to brownish yellow (10YR 6/8), mottled, ~~wet~~, moist, plastic soft to firm.
			~~Note: some pieces removed to used to plug hole. We dropped pull cap down and lost. To seal it off from rest of well.~~ Did not do this (Changed mind).
Run		29.0 – 31.0	29.0'-31.0' - No Recovery F.G.

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Materials amounts are estimated by % volume instead of % weight.
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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 3

Borehole Number: 22198
Location - North: East:
Date: 09-09-98
Geologist: F. Grigsby Rig & Log
Drilling Equip.: Geoprobe
Surface Elevation:
Area: N. PA Plume
Total Depth: 23'
Company: Tierra Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL DATE

Top/Bottom of Core Interval	Top/Bottom of Interval	Feet of Core Recovered (Field)	Sample Number	Flow Rate	Depth of Sample	Grain Size Distribution	USCS Symbol	Depth in Feet	Graphic Lithologic Log	SAMPLE DESCRIPTION
0.0'-11.0' Box 1 of 3	Run No. 1 0.0'-5.0' (Chip fast dug out) Rec. 3.7'							0	Ap	0'-0.6' - Asphalt
							SW	1		0.6'-1.1' - Gravelly sd. - some clay - discolored Road fill)
							CL			1.1'-2.0' Clay - some Gravel - Dark yellowish Brown (10YR-4/2) - Fill - Dry -
								2		2.0'-2.2' - Broken cobble.
							CL	3		2.2'-3.6' - Sandy Clay - some gravel & Asphalt - Brownish Black (5YR-2/1) to black (N1) - Dry - Friable - fill material
							CL			3.6'-4.0' - Clay - pale yellowish Brown (10YR-4/2) and light brown (5YR-6/4) Very sl. damp - dense & friable - est. Med. plasticity -
							SC	4		4.0'-4.2' Clayey sand - Tr. gravel - Light Brown (5YR-5/6). Dry - friable.
							CL	5		4.2'-5.6' - Clay - some sd. Tr. Gravel - Light Olive Gray (5Y-6/1) with moderate yellowish Brown (10YR-5/4)
	Run No. 2 5.0'-8.0' Rec. 3.0'						SC	6		grading to Moderate yellowish Brown (10YR-5/4) with some Light Brownish gray (5YR-6/1) - Very fine grained sandy interval at top of core (± 0.1') Fe (yellowish gray - 5Y-8/1) Intervals of asphaltic material 0.1' at 5.0' (top of run) & 5.4' (Pulled up from bottom of hole for loose red) Clay Very slightly damp - dense & friable
							CL	7		
	Run No. 3 8.0'-11.0' Rec. 1.6'							8		
							GM	9		5.6'-6.1' - Clayey sd. - Moderate yellowish Brown (10YR-5/4) - Fed. fine to med. - fair sorted - friable. Sl. damp.
								10		6.1'-8.4' Clay - Tr. silt. Fed. Dark yellowish Brown (10YR-4/2) with Moderate yellowish Brown (10YR-5/4) Composed of clay fragments (recemented) - Sl. damp - friable & Dense

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Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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U.S. DEPARTMENT OF ENERGY ROCKY FLATS PLANT

FORM GT.1A REV. 2

ROCKY FLATS PLANT BOREHOLE LOG

PAGE 2 OF 3

Borehole Number: 22198
Location - North: East:
Date: 9-9-98
Geologist: E. Grigsby
Drilling Equip.: Geoprobe

Surface Elevation:
Area: N. PA Plume
Total Depth: 23'
Company: Terra
Sample Type: Continuous Core
Project No.:

EG&G LOGGING SUPERVISOR APPROVAL DATE

SAMPLE DESCRIPTION

Box 1 of 3 — Run No. 3

6.1 - 8.4' - Cont. Gravel as 7-8.8.0' ~~[illegible]~~ FG

Run No. 4 11.0'-14.0' Rec 2.8'

8.4' - 9.6' - Sandy gravel. some clay. Matrix. Pale yellowish brown core. (dry) gravel to 1.5" (coarse) subrounded quartzite. Bottom of core is wet

9.6 - 11.0' - No Rec

11.0 - 13.8 - Sandy clay - Ft. gravel at top of interval. - Med. grayish orange (10YR 7/4) Core sl. damp - mod. friable - weathered.

Box 2 of 3 11.0'-19.6' Run No. 5 14.0'-17.0' Rec 3.0'

13.8 - 14.0' - No Rec

14.0 - 17.0' - Clayey sd. - Pale yellowish brown (10YR 6/2) and Dark yellowish orange (10YR 6/6) Sd. Fres. 2.0 - subang to rounded quartz. Sl. damp - friable. Some very sandy intervals - wx

17.0 - 18.3 Sandy Clay - Same 11.0 - 13.8

Box 3 Run No. 6 17.0'-20.0' Rec 4.0' Slough (4.0 - 1 slushed)

18.3 - 21.0 ± - Clayey ~~Sandstone~~ Sandstone Dark yellowish orange (10YR 6/6) Grayish orange (10YR 7/4) and Pale yellowish brown (10YR 6/2) - Abundant slough mixed with core - Depths questionable - Core damp - May be Laramie Channel - Sands VFG to f.G. sub ang. to rounded quartz (well sorted or poorly graded).

Depth (ft): 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20
01 · 40 · 01 · 50

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22198
Location - North: ______ East: ______
Date: 9-9-98
Geologist: F. Grigsby - Rig & Log
Drilling Equip.: GeoProbe
Surface Elevation: ______
Area: ______
Total Depth: ______
Company: ______ Project No.: ______
Sample Type: ______

EG&G LOGGING SUPERVISOR
APPROVAL ______ DATE ______

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 3 of 3 17.6' - 23.0'	Run No 7 20.0' - 22.0'	Rec. 4.0'	Slough - Over Pushed Sleeve				SC	20		
							CL	21		21-22.0' - Clay - Some Silt & Sd - Pale Yellowish Brown (10YR-6/2) with Grayish Orange (10YR-7/4) Very Slightly Sl. Damp - Weathered - Gravel Clast imbedded Friable. - Core Wet In Core at 21.8'
	Run No. 8 22.0' - 26.0'	Rec. 4.0'	Slough - Over Pushed Sleeve				SC	22		22.0' - 22.7' Clayey Sd - Some is 18.3 - 22.0' (wet)
								23 TD		22.7' - 23.0' Claystone - Top of Bedrock - Pale Yellowish Brown (10YR 6/2) Abundant Ironstone - Clast. Core wet.
								24		

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
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2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

PAGE 1 OF 2

Borehole Number: 22298
Location - North: East:
Date: 09-14-98
Geologist: E. Grigsby - Rig & Log
Drilling Equip.: Geoprobe
Surface Elevation:
Area: N. PA. - Nitrate Plume
Total Depth:
Company: Tierra
Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL
DATE

TOP/BOTTOM OF CORE IN BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE IN INTERVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 1 of 3 0.0'-9.2	Run No 1 0.0'-5.0' (1.15' Dug out for Asph)	Rec 3.4' (Moisture)						0	A A A A	0.0'-0.6' - Asphalt
								1		0.6'-1.15' - Sand & gravel - road base - Geomembrane at bottom of hole. - Material Discarded.
							CL			1.15'-1.6' Gravelly Clay - Tr. sd Dark Yellowish Brown (10YR-4/2) Est. med to high plasticity. Some Black (N1) asphaltic material (5%) - Fill material
							GM	2		1.6'-2.9' Sandy Gravel - Abundant asphalt - Brownish Black (5YR-2/1) Fill Material - Friable -
							CL	3		2.9'-4.2' Sandy Clay - Tr. gravel Moderate Yellowish Brown (10YR-5/4) with light olive gray (5Y-6/1). Est. med. plasticity. Wx - Clay very slightly damp - Sl. friable.
							CL	4		4.2'-4.5' - Sand clay - Tr. Gravel - Big gravel clast at top of interval Brownish Black (5YR-2/1)
	Run No. 2 5.0'-9.0'	Rec 4.0' (slough in hole)						5		4.5'-5.0' - No Rec.
							CL.	6		5.0'-5.4' Sandy Clay - same as 2.9-4.2
								7		5.4'-6.0' sandy clay - same as 4.2-4.5
							CL	8		6.0-~~8.7~~ 7.4' - Sandy Clay - Tr. gravel - Dark Yellowish Brown (10YR-4/2) grading to Moderate Yellowish Brown (10YR-5/4). Sand inc. interval more sandy than above - Mod. friable, Wx.
Box 2 of 3	Run No 3						CL	9		7.4'-8.7' Gravelly Clay - ~~some~~ sd. Pred. Moderate Yellowish Brown (10YR-5/4) - Some Pale Yellowish Brown (10YR-6/2) - Gravel to broken Cobble size - Sand content varies-
								10		

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(2) Core breaks cannot be matched, accurate footage measurements not possible.

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ROCKY FLATS PLANT BOREHOLE LOG

Borehole Number: 22298
Location - North: East:
Date: 09-14-98
Geologist: E. Grigsby. Rig & Log
Drilling Equip.: Geoprobe
Surface Elevation:
Area: N. PA Nitrate Plume
Total Depth: 20.0'
Company: Tierra
Project No.:
Sample Type: Continuous Core

EG&G LOGGING SUPERVISOR
APPROVAL DATE

TOP/BOTTOM OF CORE BOX	TOP/BOTTOM OF INTERVAL	FEET OF CORE RETRIEVAL (FIELD MEASUREMENT)	SAMPLE NUMBER	FRACTURE ANGLE	BEDDING ANGLE	GRAIN-SIZE DISTRIBUTION	USCS SYMBOL	DEPTH IN FEET	SOIL/LITHOLOGIC LOG	SAMPLE DESCRIPTION
Box 2 of 3 9.2'-15.6'	Run No. 3 9.0'-12.0'	Rec. 3.6 (slough in hole)						10		2.4-8.7 - Cont. Core varies from mod. friable to non friable. - Est. plasticity is low to med. - Int. wx., sl. damp
								11		8.7'-16.6' - Silty Clay - some sd. - Color varies from Dark yellowish orange (10YR 6/6) and Grayish orange (10YR 7/4) to Pale yellowish brown (10YR 6/2) in interbedded clayey intervals. Sand content varies - Entire interval heavily weathered. Ironstone nodule at bottom of interval.
	Run No. 4 12.0'-15.0'	Rec. 4.0' (slough in hole)					Cl	12-15		
Box 3 of 3 15.6'-20.0	Run No. 5 15.0'-18.0'	Rec. 4.0' (slough in hole)						16-17		16.6-20.0' - Top of (Claystone Bedrock) Claystone - Tr. Silt. Pale yellowish Brown (10YR 6/2) Some Grayish Orange (10YR 7/4) Fe ~~Stained~~ Staining. - Core very sl. damp & mod. indurated.
	Run No. 6 18.0'-20.0'	Rec. 2.9' (slough in hole)						18-20		TD.

NOTES: General: USCS is modified for this log as follows:
Materials amounts are estimated by % volume instead of % weight.
(1) Badly broken core, accurate footage measurements not possible.
(2) Core breaks cannot be matched, accurate footage measurements not possible.

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Appendix C.2

1998 Well Construction ~~Logs~~ Diagrams

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
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ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: #00198 PROJECT NAME: 903 Plume Characterization PROGRAM: RMRS-ER

SCREENED FORMATION: Bedrock Siltstone DRILLING CONTRACTOR: UNIVERSAL / IT CORPORATION

DRILLING METHOD: GEOPROBE ~~HAND POKE~~ DATE DRILLED: 03/17/98 DATE COMPLETED: 03/1…

RIG GEOLOGIST: J Cox / E TUTH LOGGING GEOLOGIST: Jim Cox/E. TUTH

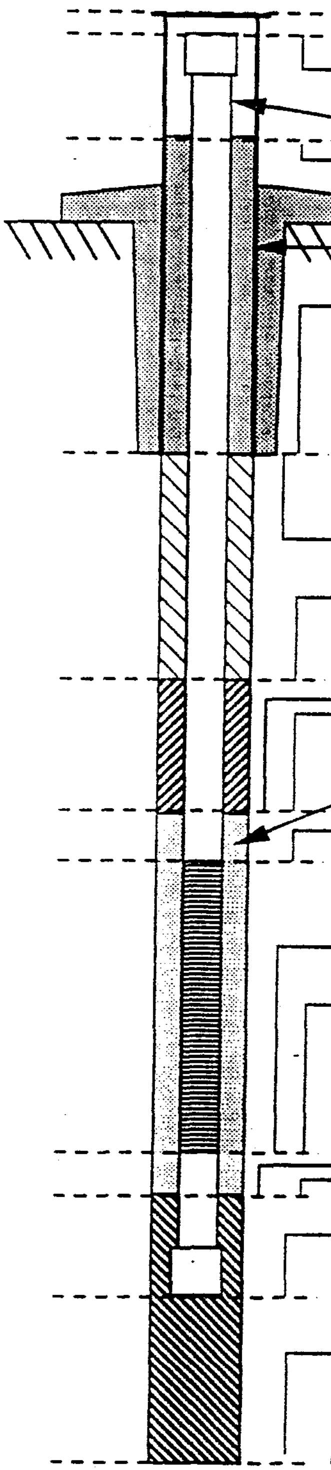
COMPLETED DEPTH (FT): 16.4 ESTIMATED DEPTH TO BEDROCK (FT): 8.6

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): 15.25* DATE MEASURED: 3/23/98

COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 5/4/98



PROTECTIVE CASING, TOP (FT): 1 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1 ft. ABOVE GS

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC Sch. 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: Hydrated ~~Aquaset Granular~~ Bentonite Plug (Chip

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC Sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.5' Below

IF APPLICABLE

SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Hydrated ~~Aquaset Granular~~ Bent… Plug (Ch…)

BENTONITE SEAL, BOTTOM (FT): 10.4

FILTER PACK, TOP (FT): 10.4

FILTER PACK TYPE: 16/40 silica sand BRAND: ~~CCS~~ CSS

SURFACE CASING, BOTTOM (FT): 11.4 SCREEN, TOP (FT): 11.4

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 16.2 TYPE: PVC sch 40 BRAND: CCS

SUMP, TOP (FT): 16.2 TYPE: PVC sch 40 end cap

FILTER PACK, BOTTOM (FT): 16.4

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 16.4

TOTAL DEPTH (FT): 16.4

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: completed in borehole #00198A Bentonite Hydrated w/ 1 gal. of Distilled water *Purged on 4/22 …

COMPLETED BY: Jim Cox IT CORPORATION DATE: 3/18/98

CHECKED BY: [signature] IT DATE: 3/23/98

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U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 00298 PROJECT NAME: Ryan's Pit/903 Pad Plum PROGRAM: RMRS - ER

SCREENED FORMATION: weathered BR. DRILLING CONTRACTOR: UNIVERSAL / IT CORP.

DRILLING METHOD: Geoprobe ~~Hammer~~ DATE DRILLED: 3/25/98 DATE COMPLETED: 3/25/98

RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox

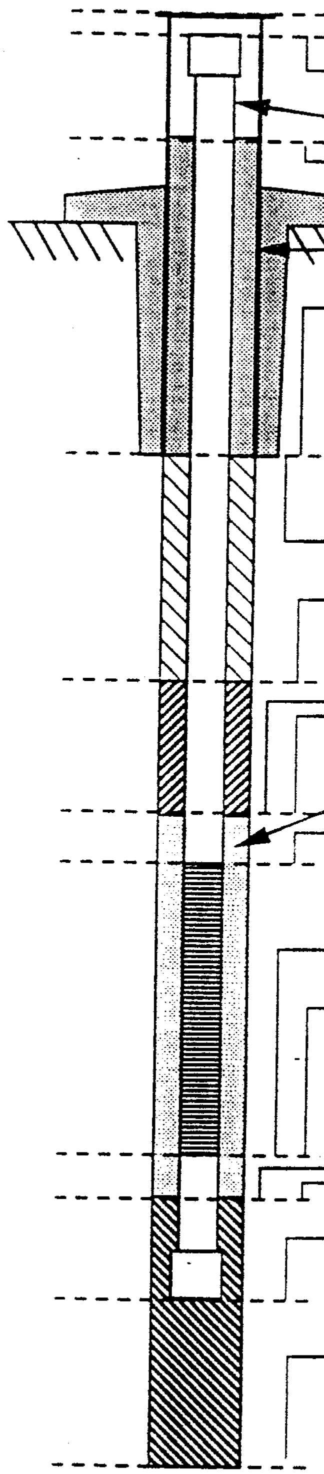
COMPLETED DEPTH (FT): 12.5' ESTIMATED DEPTH TO BEDROCK (FT): 2.6

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): 9.69' DATE MEASURED: 3/26/98

COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 5/5/98



PROTECTIVE CASING, TOP (FT): 1.0' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.0'

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: ~~Aquaset~~ Hydrated ~~Gran.~~ Bentonite

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40 Plastic

PROTECTIVE CASING, BOTTOM (FT): 1.0'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.0 TYPE: ~~Aquaset~~ Hydrated ~~Gran.~~ Bent. Plug (chips)

BENTONITE SEAL, BOTTOM (FT): 6.3'

FILTER PACK, TOP (FT): 6.3'

FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS

SURFACE CASING, BOTTOM (FT): 7.5' SCREEN, TOP (FT): 7.5'

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 12.3 TYPE: PVC sch 40 BRAND:

SUMP, TOP (FT): 12.3 TYPE: PVC sch 40 end cap

FILTER PACK, BOTTOM (FT): 12.5

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 12.5

TOTAL DEPTH (FT): 12.5

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: hydrated bentonite w/ ~~about~~ < 1 gal. of distilled water. Purged on 4/22 - 300 ml.

COMPLETED BY: Jim Cox DATE: 4/6/98

CHECKED BY: Dan Granveding DATE: 4/8/98

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Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 00398 weather PROJECT NAME: 903 PAD/Ryan's Pit Plume PROGRAM: RMRS - ER

SCREENED FORMATION: Bedrock siltstone DRILLING CONTRACTOR: UNIVERSAL / IT CORPORATI

DRILLING METHOD: Geo probe ~~HALLCUCLE~~ DATE DRILLED: 3/23/98 DATE COMPLETED: 3/2 8

RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox IT CORP.

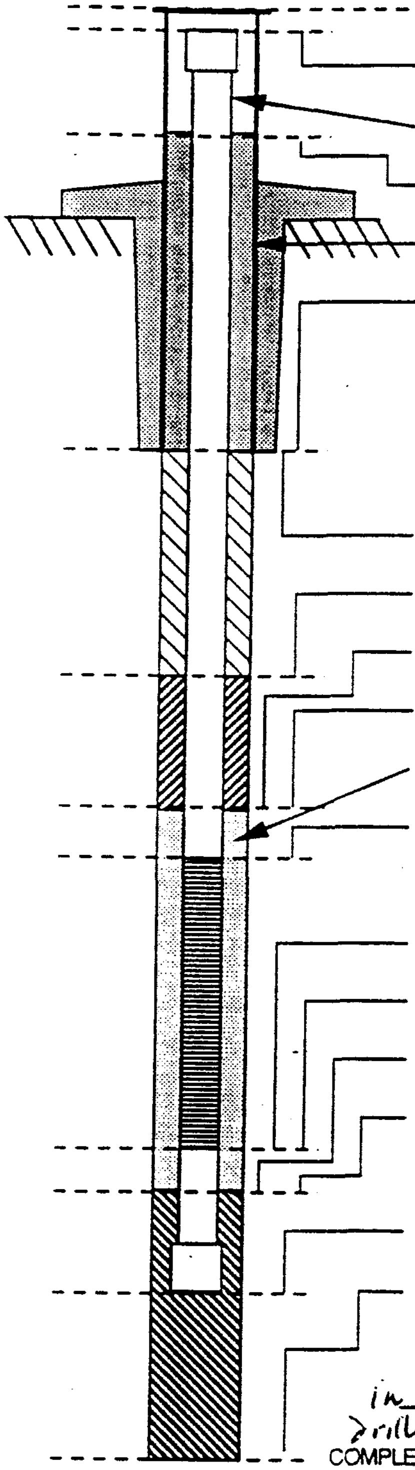
COMPLETED DEPTH (FT): 15.0' ESTIMATED DEPTH TO BEDROCK (FT): 9.3

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ______

INITIAL WATER LEVEL (FT): 13.42 DATE MEASURED: 3/26/98

COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 5/5/98



PROTECTIVE CASING, TOP (FT): 0.8' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.8'

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: Hydrated ~~Aquaset Granular~~ Bentonite Plus Chips

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40

PROTECTIVE CASING, BOTTOM (FT): 1.2'

IF APPLICABLE

SECONDARY CASING, TOP (FT): NA BOTTOM (FT): ______

SECONDARY CASING, I.D. (IN): NA TYPE: ______

CENTRALIZER, O.D. (IN): NA TOP (FT): ______ BOTTOM (FT): ______

GROUT SEAL, TOP (FT): NA TYPE: ______

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Hydrated ~~Aquaset Granular~~ Bent ite Plug Chips

BENTONITE SEAL, BOTTOM (FT): 8.6'

FILTER PACK, TOP (FT): 8.6'

FILTER PACK TYPE: 16/40 silica Sand BRAND: ~~CCS~~ CSS

SURFACE CASING, BOTTOM (FT): ~~9.8'~~ 10' (DC) SCREEN, TOP (FT): ~~9.8'~~ 10.0' (DC)

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 14.8' TYPE: PVC sch 40 BRAND: ______

SUMP, TOP (FT): 14.8' TYPE: PVC sch 40 end cap.

FILTER PACK, BOTTOM (FT): 15.0'

BACKFILL, TOP (FT): 15.0' TYPE: A Granular Bentonite

BACKFILL, BOTTOM (FT): 16.0' NO WATER ADDED.

SUMP, BOTTOM (FT): 15.0'

TOTAL DEPTH (FT): 16.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: completed in Borehole #00398 - some moisture in clay at below 14' otherwise dry - 1 ft steel weight from drillers tape lodged in filter pack at 14.6-13.6 could not be removed.

COMPLETED BY: ~~Jim Cox~~ DATE: ~~3/23/98~~

CHECKED BY: DAN GRAVENDING DATE: 4/8/98

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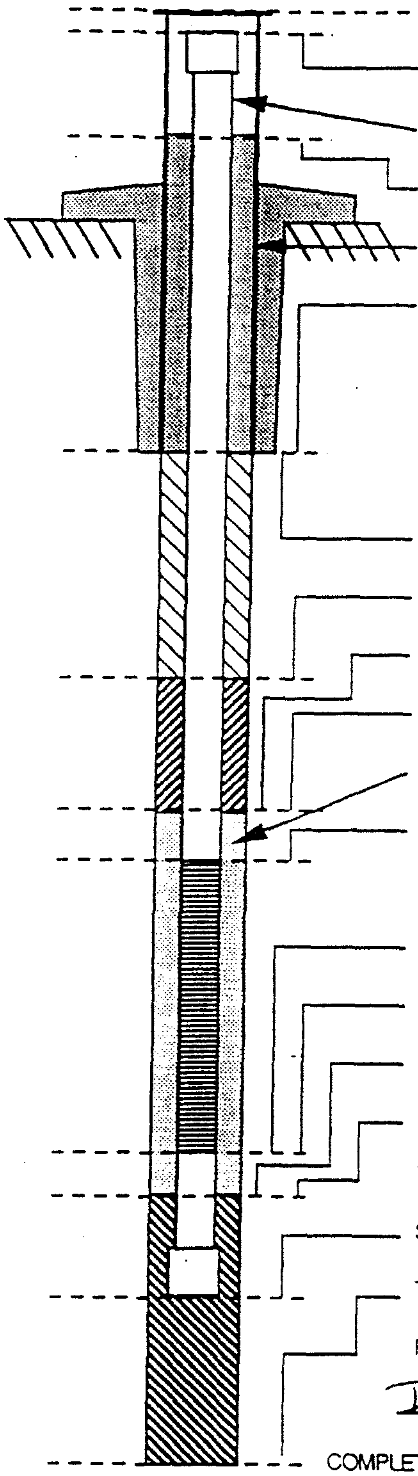
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 00498 PROJECT NAME: Ryan's Pit/903 PAD PLUME PROGRAM: RMRS - EX ER
SCREENED FORMATION: Weathered BR/Colluvium DRILLING CONTRACTOR: UNIVERSAL / IT CORP.
DRILLING METHOD: GEOPROBE ~~HAMMER~~ DATE DRILLED: 3/25/98 DATE COMPLETED: 3/25/98
RIG GEOLOGIST: JIM COX LOGGING GEOLOGIST: JIM COX
COMPLETED DEPTH (FT): 14.0 ESTIMATED DEPTH TO BEDROCK (FT): 9.7
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): 13.34' BGS. DATE MEASURED: 3/26/98
COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 5/5/98



PROTECTIVE CASING, TOP (FT): 1.10' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.0'
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC Sch 40
SURFACE SEAL, TOP (FT): 0.0 TYPE: ~~Aquaset Granular Bent~~ Hydrated Bentonite Plug (Ch
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC Sch 40
PROTECTIVE CASING, BOTTOM (FT): ~~1.0'~~ 0.9'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0 TYPE: ~~Aquaset Gran. Bent.~~
BENTONITE SEAL, BOTTOM (FT): 7.8' Hydrated Bentonite Plug (Chi
FILTER PACK, TOP (FT): 7.8'
FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 9.0' SCREEN, TOP (FT): 9.0'
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 13.8 TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): 13.8 TYPE: PVC sch 40 end cap
FILTER PACK, BOTTOM (FT): 14.0
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 14.0
TOTAL DEPTH (FT): 14.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Hydrated Bentonite slowly w/ ± 1/4 gal of Distilled water.

COMPLETED BY: Jim Cox IT DATE: 3/25/98
CHECKED BY: Dan Granadino DATE: 4/8/98

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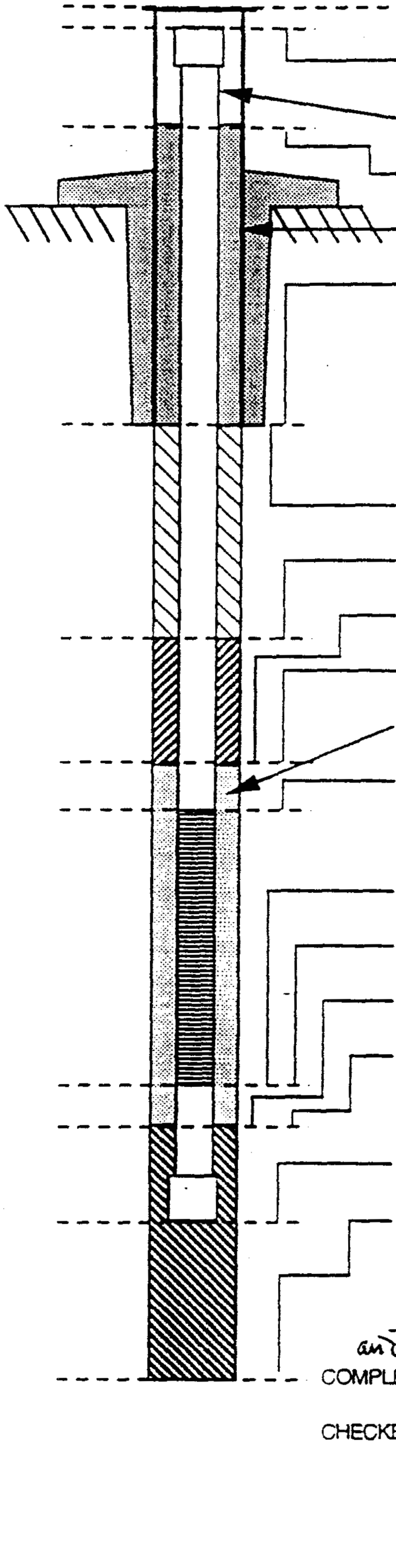
(Rev. ~~3~~) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 00598
PROJECT NAME: 903 PAD/RYAN'S PIT PLUME
PROGRAM: RMRS - ER
SCREENED FORMATION: weathered BR.
DRILLING CONTRACTOR: UNIVERSAL / IT CORP
DRILLING METHOD: Geoprobe
DATE DRILLED: 3/24/98
DATE COMPLETED: 3/2
RIG GEOLOGIST: Jim Cox
LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 20.4
ESTIMATED DEPTH TO BEDROCK (FT): 5.4
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): DRY
DATE MEASURED: 03/24/98
COMPLETED WATER LEVEL (FT): DRY
DATE MEASURED: 5/5/98



PROTECTIVE CASING, TOP (FT): 0.9' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.9'

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: ~~Aquaset Gran~~ Hydrated Bentonite Plug (chips)

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40

PROTECTIVE CASING, BOTTOM (FT): 1.1'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Hydrated Bentonite Plug (Ch

BENTONITE SEAL, BOTTOM (FT): 9.0'

FILTER PACK, TOP (FT): 9.0'

FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS

SURFACE CASING, BOTTOM (FT): 10.4' SCREEN, TOP (FT): 10.4

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 20.2 TYPE: PVC. Sch. 40 BRAND:

SUMP, TOP (FT): 20.2 TYPE: PVC. sch 40 threaded Cap.

FILTER PACK, BOTTOM (FT): 20.4

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 20.4

TOTAL DEPTH (FT): 20.4

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Bentonite hydrated w/ < 1 quart of water. - During construction top riser (1.4') snapped at threads and replaced - some minor amount of bentonite fell into well.

COMPLETED BY: Jim Cox DATE: 4/6/9

CHECKED BY: DAN GRAVERDING DATE: 4/8/98

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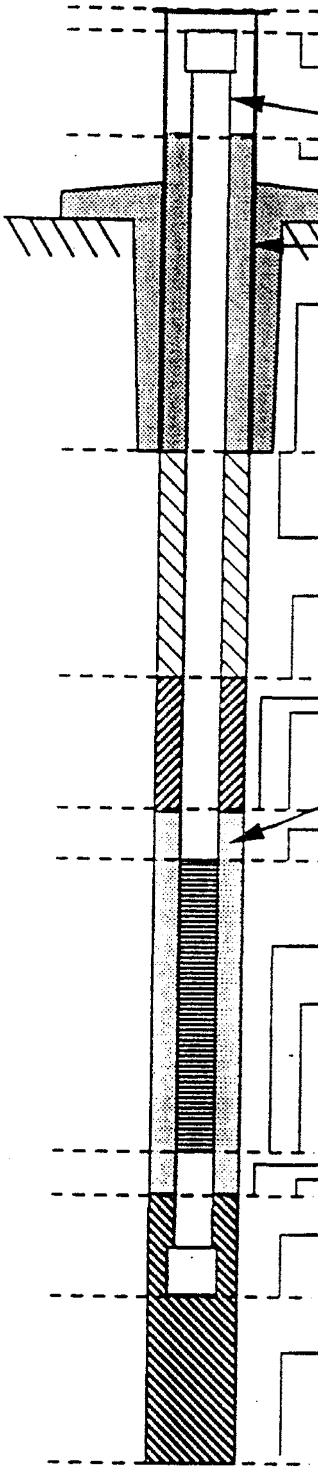
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 00698
PROJECT NAME: 903PAD/RYANS PIT PLUME
PROGRAM: RMRS-ER
SCREENED FORMATION: weathered BR.
DRILLING CONTRACTOR: UNIVERSAL / IT CORP.
DRILLING METHOD: Geoprobe
DATE DRILLED: 3/24/98
DATE COMPLETED: 3/24/98
RIG GEOLOGIST: Jim Cox
LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 18.2
ESTIMATED DEPTH TO BEDROCK (FT): 10.0
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): 13.15 *
DATE MEASURED: 3/25/98
COMPLETED WATER LEVEL (FT): DRY
DATE MEASURED: 5/5/98



PROTECTIVE CASING, TOP (FT): 1.0' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.0'
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch. 40
SURFACE SEAL, TOP (FT): 0.0 TYPE: Hydrated Bentonite Plug (chip)
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch. 40
PROTECTIVE CASING, BOTTOM (FT): 1.0'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0 TYPE: Hydrated Bentonite Plug (chip)
BENTONITE SEAL, BOTTOM (FT): 12.2
FILTER PACK, TOP (FT): 12.2
FILTER PACK TYPE: 16/40 silica sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 13.2 SCREEN, TOP (FT): 13.2
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 18.0 TYPE: PVC sch. 40 BRAND:
SUMP, TOP (FT): 18.0 TYPE: PVC sch. 40 threaded end cap.
FILTER PACK, BOTTOM (FT): 18.2
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): NA
TOTAL DEPTH (FT): ~~18.0~~ 18.2

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Hydrated bentonite w/ 1 gal of Distilled water.
* Purged on 4/22/98 - 75 ml.

COMPLETED BY: Jim Cox DATE: 4/6/98
CHECKED BY: Dan Gravbroding DATE: 4/8/98

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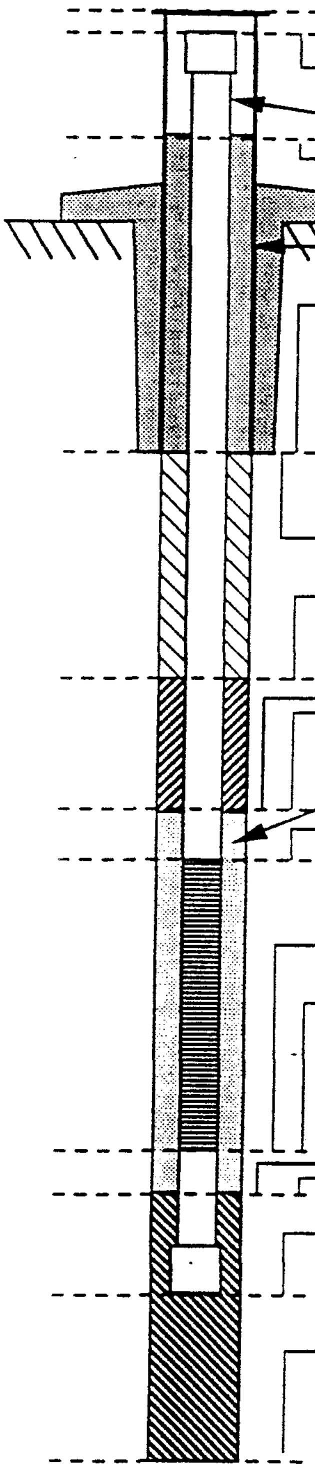
(Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 00798
PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RM25 - ER
SCREENED FORMATION: weathered BR
DRILLING CONTRACTOR: UNIVERSAL - IT CORP
DRILLING METHOD: Geoprobe
DATE DRILLED: 3/26/98
DATE COMPLETED: 3/2[illegible]8
RIG GEOLOGIST: Jim Cox
LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 14.1
ESTIMATED DEPTH TO BEDROCK (FT): 5.0
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): 13.63
DATE MEASURED: 03/26/98
COMPLETED WATER LEVEL (FT): DRY
DATE MEASURED: 5/5/98



PROTECTIVE CASING, TOP (FT): 0.90' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.90'
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch. 40
SURFACE SEAL, TOP (FT): 0.0 TYPE: Hydrated Bentonite Plus (Chi...
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC. sch. 40
PROTECTIVE CASING, BOTTOM (FT): 1.1'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0' TYPE: Hydrated Bentonite Plus (chips)
BENTONITE SEAL, BOTTOM (FT): 7.7'
FILTER PACK, TOP (FT): 7.7'
FILTER PACK TYPE: 16/40 silica sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 9.1' SCREEN, TOP (FT): 9.1'
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 13.9 TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): ~~14.1~~ 13.9 TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 14.1
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 14.1
TOTAL DEPTH (FT): 14.1

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Hydrated w/ 1/4 gal of distilled water

COMPLETED BY: Jim Cox DATE: 4/6/98
CHECKED BY: DAN GRAVELDING DATE: 4/8/98

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Form GT.6B
(Rev.3)
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Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 00898
PROJECT NAME: 903 PAD/RYAN'S PIT PLUME
PROGRAM: RMRS-ER

SCREENED FORMATION: weathered BR
DRILLING CONTRACTOR: UNIVERSAL / IT CORP.

DRILLING METHOD: geoprobe
DATE DRILLED: 3/27/98
DATE COMPLETED: 3/27/98

RIG GEOLOGIST: DAN GRAVELDING
LOGGING GEOLOGIST: Jim Cox

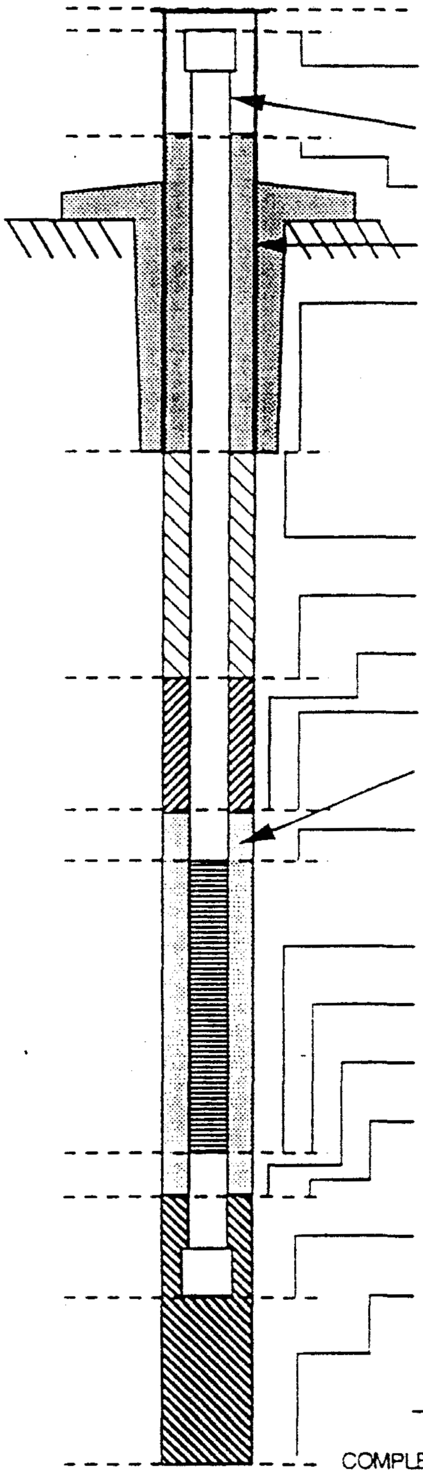
COMPLETED DEPTH (FT): 16.1
ESTIMATED DEPTH TO BEDROCK (FT): 4.0

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): DRY
DATE MEASURED: 4/1/98

COMPLETED WATER LEVEL (FT): DRY
DATE MEASURED: 5/5/98



PROTECTIVE CASING, TOP (FT): 1.0' (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.0'

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: Hydrated Bentonite Plus (Chip)

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40

PROTECTIVE CASING, BOTTOM (FT): 1.0'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.0' TYPE: Hydrated Bentonite Plus (chip)

BENTONITE SEAL, BOTTOM (FT): 10.1'

FILTER PACK, TOP (FT): 10.1'

FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS

SURFACE CASING, BOTTOM (FT): 11.1' SCREEN, TOP (FT): 11.1'

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 15.9' TYPE: PVC sch 40 BRAND:

SUMP, TOP (FT): 15.9' TYPE: PVC sch 40 threaded end cap

FILTER PACK, BOTTOM (FT): 16.1'

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 16.1'

TOTAL DEPTH (FT): 16.1'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Hydrated Bentonite w/ 1/2 gal of distilled water.

COMPLETED BY: Jim Cox DATE: 4/6/98

CHECKED BY: DAN GRAVELDING DATE: 4/8/98

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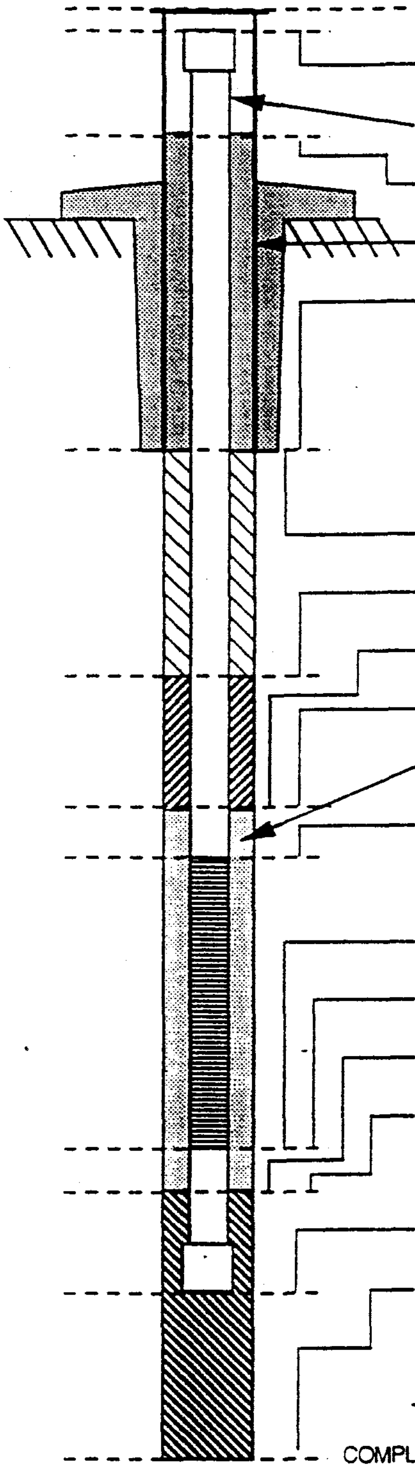
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: CC99B PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER
SCREENED FORMATION: weathered BR/cdlw DRILLING CONTRACTOR: UNIVERSAL / IT CORPORATION
DRILLING METHOD: Geoprobe DATE DRILLED: 4/1/98 DATE COMPLETED: 4/1/9
RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 10.0' ESTIMATED DEPTH TO BEDROCK (FT): 4.6
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 4/1/98
COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 5/5/98



PROTECTIVE CASING, TOP (FT): 1.0' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.0'
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): 0.0 TYPE: Gran. Bent. Hydrated w/spray
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT): 0.7'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular Bentonite Hydrated w/spray
BENTONITE SEAL, BOTTOM (FT): 3.8
FILTER PACK, TOP (FT): 3.8'
FILTER PACK TYPE: 16/40 silica sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 5.0' SCREEN, TOP (FT): 5.0'
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 9.8' TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): 9.8' TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 10.0'
BACKFILL, TOP (FT): 10.0' TYPE: Bentonite (plus) Chip Not Hydrated
BACKFILL, BOTTOM (FT): 12.1'
SUMP, BOTTOM (FT): 10.0'
TOTAL DEPTH (FT): 12.1'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Hydrated Bentonite slowly w/ spray bottle

COMPLETED BY: Jim Cox DATE: 4/6/98
CHECKED BY: DAN GRAVEDING DATE: 4/8/98

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Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01098 PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER

SCREENED FORMATION: ~~[illegible]~~ colluvium DRILLING CONTRACTOR: IT CORP / UNIVERSAL

DRILLING METHOD: Geoprobe DATE DRILLED: 4/10/98 DATE COMPLETED: 4/10/98

RIG GEOLOGIST: Dan Gravelding LOGGING GEOLOGIST: Jim Cox

COMPLETED DEPTH (FT): 12.4 ESTIMATED DEPTH TO BEDROCK (FT): ~~10.9~~ not encountered

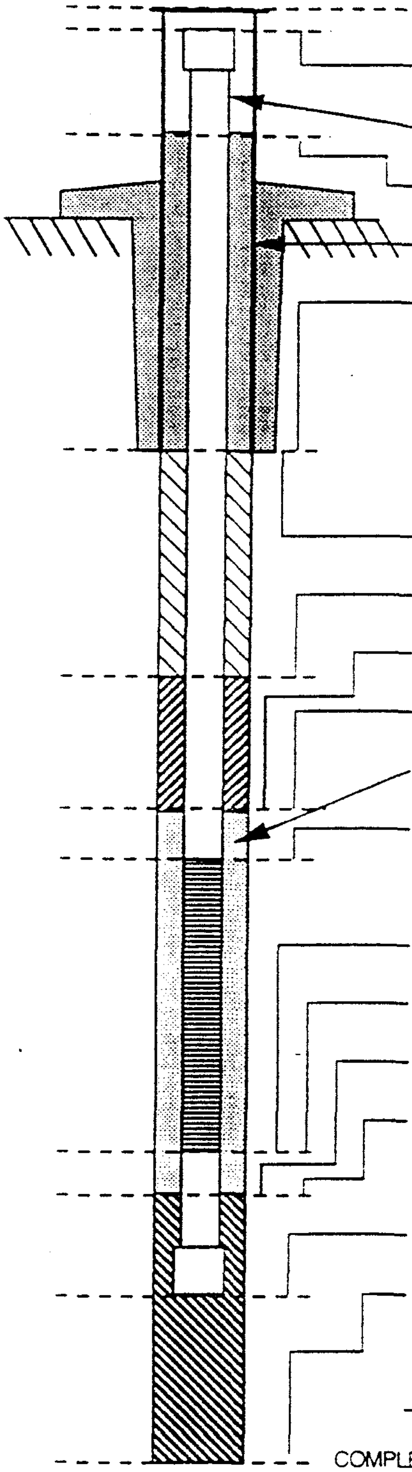
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2"

foam block.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): Ø0

INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 4/14/98

COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 4/29/98



PROTECTIVE CASING, TOP (FT): 0.90 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.90

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: gran. bent. hydrated w/ spray

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.50

IF APPLICABLE

SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): ~~4.0~~ 3.4 TYPE: Bent. Plug. (NOT HYDRATE

BENTONITE SEAL, BOTTOM (FT): 6.4'

FILTER PACK, TOP (FT): 6.4'

FILTER PACK TYPE: 16/40 silica sand BRAND: CSS

SURFACE CASING, BOTTOM (FT): 7.4' SCREEN, TOP (FT): 7.4'

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 12.2 TYPE: PVC sch 40 BRAND:

SUMP, TOP (FT): 12.2 TYPE: PVC sch 40 threaded end cap

FILTER PACK, BOTTOM (FT): 12.4

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 12.4

TOTAL DEPTH (FT): 12.4

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Jim Cox (from logbook) DATE: 4/10/98

CHECKED BY: [signature] DATE: 5.11.98

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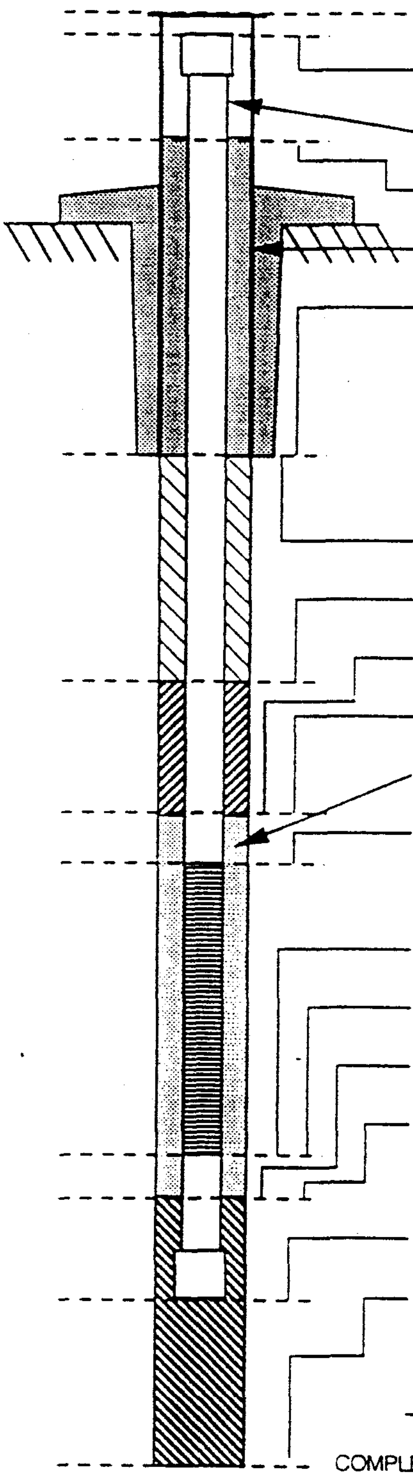
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01198
PROJECT NAME: 903 PAD/RYAN'S PIT PLUME
PROGRAM: RMRS-ER
SCREENED FORMATION: WBR / COLL.
DRILLING CONTRACTOR: IT / UNIVERSAL
DRILLING METHOD: Geoprobe
DATE DRILLED: 4/9/98
DATE COMPLETED: 4/9/98
RIG GEOLOGIST: Jim Cox
LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 20.4
ESTIMATED DEPTH TO BEDROCK (FT): 18.8
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0
INITIAL WATER LEVEL (FT): DRY
DATE MEASURED: 4/10/98
COMPLETED WATER LEVEL (FT): DRY
DATE MEASURED: 4/29/98



PROTECTIVE CASING, TOP (FT): 1.10 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.10
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): 0.0 TYPE: Gran. bentonite hydrated w/ 5g
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT): 0.60

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 3.0 TYPE: Bent. med. plug. NOT HYDRATED.
BENTONITE SEAL, BOTTOM (FT): 9.3
FILTER PACK, TOP (FT): 9.3
FILTER PACK TYPE: 16/40 silica sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 10.4 SCREEN, TOP (FT): 10.4
SCREEN SLOT SIZE (.000 IN): SCREEN, I.D. (IN):
SCREEN, BOTTOM (FT): 20.2 TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): 20.2 TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 20.4
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 20.4
TOTAL DEPTH (FT): 20.4

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: partner well to 01198A

COMPLETED BY: Jim Cox DATE: 4/9/98
CHECKED BY: [signature] DATE: 5.11.98

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U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev. ~~3~~) 0RR 3/31/94

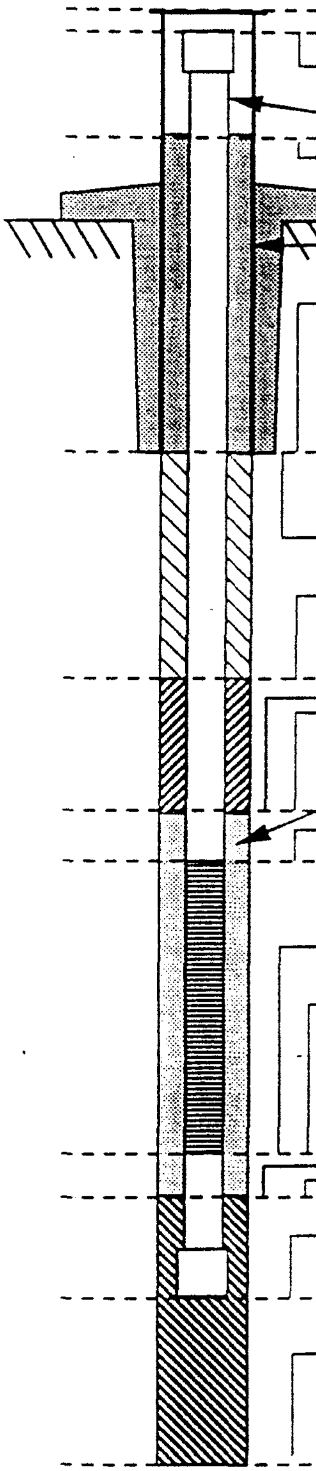
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01298
PROJECT NAME: 903 PAD/RYAN'S PIT PLUME
PROGRAM: RMRS-ER
SCREENED FORMATION: WIBR / COLL.
DRILLING CONTRACTOR: IT / UNIVERSAL.
DRILLING METHOD: geoprobe
DATE DRILLED: 4/8/98
DATE COMPLETED: 4/8/98
RIG GEOLOGIST: Jim Cox
LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 18.3
ESTIMATED DEPTH TO BEDROCK (FT): 16.3
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ______

INITIAL WATER LEVEL (FT): 18.67 DATE MEASURED: 4/9/98

COMPLETED WATER LEVEL (FT): ~~14.31~~ 13.81 DATE MEASURED: 4/28/98



PROTECTIVE CASING, TOP (FT): 1.0' (FROM GROUND SURFACE) 5c

SURFACE CASING (STICKUP), TOP (FT): 1.0'

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: gran. bent. Hydrated w/spray bottle

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.7'

IF APPLICABLE: SECONDARY CASING, TOP (FT): NA BOTTOM (FT): ______

SECONDARY CASING, I.D. (IN): NA TYPE: ______

CENTRALIZER, O.D. (IN): NA TOP (FT): ______ BOTTOM (FT): ______

GROUT SEAL, TOP (FT): NA TYPE: ______

BENTONITE SEAL, TOP (FT): 3.0 TYPE: MED BENTONITE PLUG NOT HYDRATED

BENTONITE SEAL, BOTTOM (FT): 12.1

FILTER PACK, TOP (FT): 12.1

FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS

SURFACE CASING, BOTTOM (FT): 13.3 SCREEN, TOP (FT): 13.3

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 18.1 TYPE: PVC sch 40 BRAND: ______

SUMP, TOP (FT): 18.1 TYPE: PVC sch 40 threaded end cap

FILTER PACK, BOTTOM (FT): 18.3

BACKFILL, TOP (FT): NA TYPE: ______

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): ~~NA~~ 18.3

TOTAL DEPTH (FT): 18.3

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: SAMPLED ON 4/28/98.

COMPLETED BY: Jim Cox DATE: 4/9/98

CHECKED BY: [signature] DATE: 5.11.98

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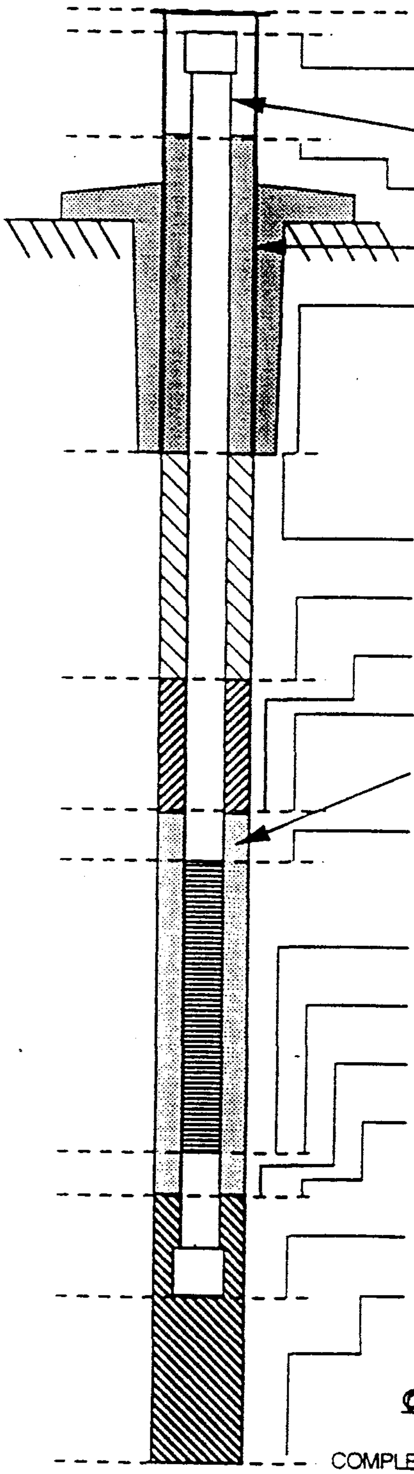
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C1398 , PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER
SCREENED FORMATION: weathered BL/Colluvium DRILLING CONTRACTOR: UNIVERSAL / IT CORP.
DRILLING METHOD: geoprobe DATE DRILLED: 4/1/98 DATE COMPLETED: 4/1/98
RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 9.0' ESTIMATED DEPTH TO BEDROCK (FT): 6.4
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 4/1/98
COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 5/5/98



PROTECTIVE CASING, TOP (FT): 0.90' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.90'
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): 0.0 TYPE: Gran. Bent. Hydrated.
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT): 0.80'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0' TYPE: Granular Bentonite Hydrated
BENTONITE SEAL, BOTTOM (FT): 2.9'
FILTER PACK, TOP (FT): 2.9'
FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 4.0' SCREEN, TOP (FT): 4.0'
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 8.8' TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): 8.8' TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 9.0'
BACKFILL, TOP (FT): 9.0' TYPE: Bentonite (Chip Plug) NOT Hydrated
BACKFILL, BOTTOM (FT): 10.10'
SUMP, BOTTOM (FT): 9.0'
TOTAL DEPTH (FT): 10.1'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Gran. Bent. Hydrated slowly w/ spray bottle of Distilled water.

COMPLETED BY: Jim Cox DATE: 4/6/98
CHECKED BY: Dan Gravedini DATE: 4/8/98

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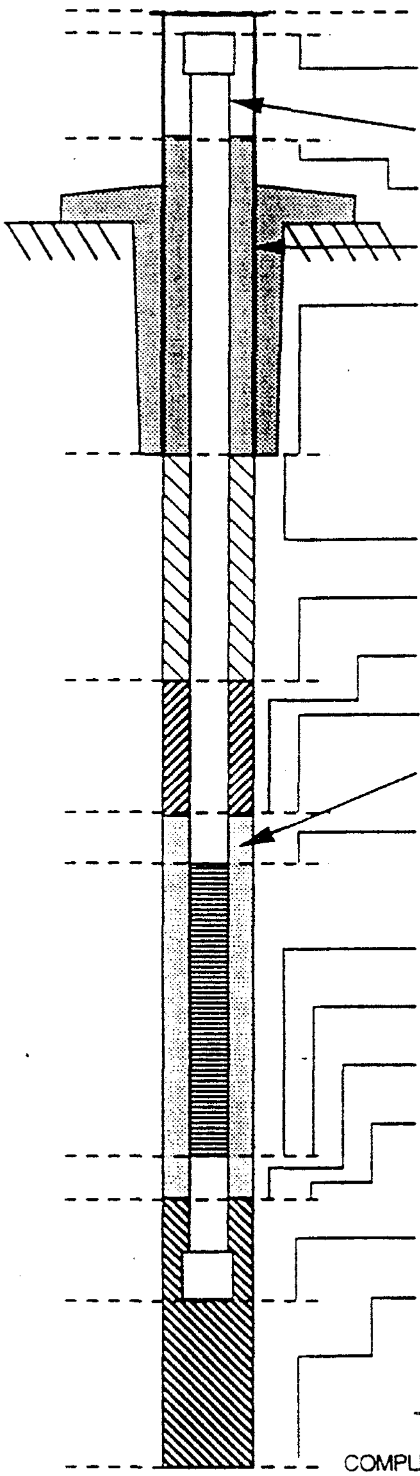
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01498 PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER
SCREENED FORMATION: weathered BR/colluvium DRILLING CONTRACTOR: UNIVERSAL / IT CORP.
DRILLING METHOD: geoprobe DATE DRILLED: 4/1/98 DATE COMPLETED: 4/1/98
RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 10.0 ESTIMATED DEPTH TO BEDROCK (FT): 6.4
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 4/1/98
COMPLETED WATER LEVEL (FT): 7.34 DATE MEASURED: 5/5/98



PROTECTIVE CASING, TOP (FT): 0.90' (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.90'
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): 0.0' TYPE: Granular Bent. Hydrated. w/spray
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT): 0.80'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0' TYPE: Granular Bent. Hydrated w/spray
BENTONITE SEAL, BOTTOM (FT): 4.0'
FILTER PACK, TOP (FT): 4.0'
FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 5.0' SCREEN, TOP (FT): 5.0'
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 9.8 TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): 9.8' TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 10.0'
BACKFILL, TOP (FT): 10.0' TYPE: Bentonite Chip NOT HYDRATED
BACKFILL, BOTTOM (FT): 10.2'
SUMP, BOTTOM (FT): 10.08'
TOTAL DEPTH (FT): 10.2'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Hydrated Granular Bent. Slowly w/ Distilled Water from a spray bottle. SAMPLED on 4/28/98

COMPLETED BY: Jim Cox DATE: 4/6/98

CHECKED BY: Dan Grahlding DATE: 4/8/98

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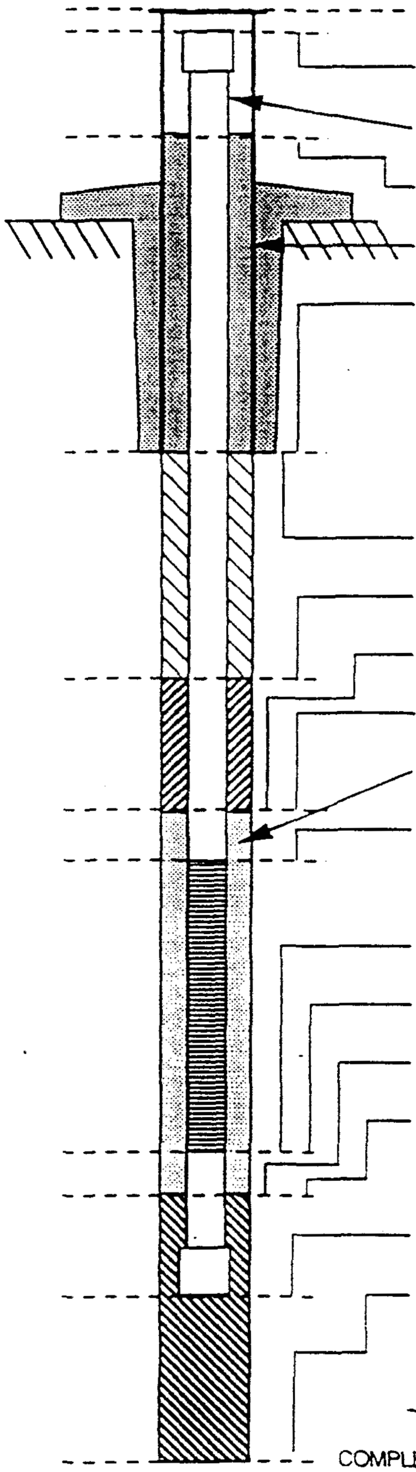
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: C1598 PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER
SCREENED FORMATION: Colluvium DRILLING CONTRACTOR: IT / UNIVERSAL
DRILLING METHOD: geoprobe DATE DRILLED: 04/17/98 DATE COMPLETED: 04/17/98
RIG GEOLOGIST: Zane Tutz LOGGING GEOLOGIST: Zane Tutz
COMPLETED DEPTH (FT): 10.2 ESTIMATED DEPTH TO BEDROCK (FT): 7.0
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0

INITIAL WATER LEVEL (FT): ~~Dry~~ Dry DATE MEASURED: 4/17/98
COMPLETED WATER LEVEL (FT): Dry DATE MEASURED: 4/24/98



PROTECTIVE CASING, TOP (FT): 0.9 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.9
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): 0.0 TYPE: granular bentonite, hydrated w/ spray
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT): 0.80

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular Bentonite, hydrated w/ spray
BENTONITE SEAL, BOTTOM (FT): 2.2
FILTER PACK, TOP (FT): 2.2
FILTER PACK TYPE: 16/40 silica sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 3.0 SCREEN, TOP (FT): 3.0
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT) 8.0 TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): 8.0 TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT)
BACKFILL, TOP (FT): 8.2 TYPE: Bentonite chip
BACKFILL, BOTTOM (FT) 10.2
SUMP, BOTTOM (FT) 8.2
TOTAL DEPTH (FT): 10.2

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Zane H Tutz DATE: 4/17/98
CHECKED BY: [signature] DATE: 5-11-98

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Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01698 PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER

SCREENED FORMATION: WBR/COLL. DRILLING CONTRACTOR: IT/UNIVERSAL

DRILLING METHOD: geoprobe DATE DRILLED: 4/21/98 DATE COMPLETED: 4/21/98

RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox

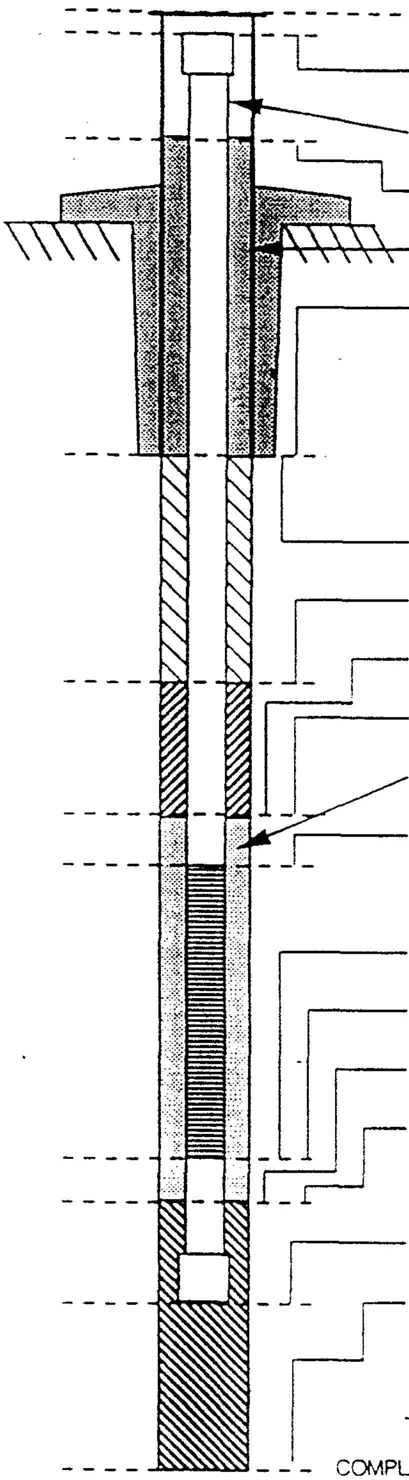
COMPLETED DEPTH (FT): 16.2 ESTIMATED DEPTH TO BEDROCK (FT): 15.3

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0

INITIAL WATER LEVEL (FT): 10.67 DATE MEASURED: 4/29/98 rising?

COMPLETED WATER LEVEL 10.67 DATE MEASURED: 5-4-98



PROTECTIVE CASING, TOP (FT): 1.0 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.0

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: Granular Bent. Hydrated w/spray

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40

PROTECTIVE CASING, BOTTOM (FT):

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 3.0 TYPE: MED. BENT PLUG

BENTONITE SEAL, BOTTOM (FT): 10.2

FILTER PACK, TOP (FT): 10.2

FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS

SURFACE CASING, BOTTOM (FT): 11.2 SCREEN, TOP (FT): 11.2

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 16.0 TYPE: PVC sch 40 BRAND:

SUMP, TOP (FT): 16.0 TYPE: PVC sch 40 threaded end cap

FILTER PACK, BOTTOM (FT): 16.2

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 16.2

TOTAL DEPTH (FT): 16.2

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Jim Cox DATE: 4/27/98

CHECKED BY: [signature] DATE: 5.11.98

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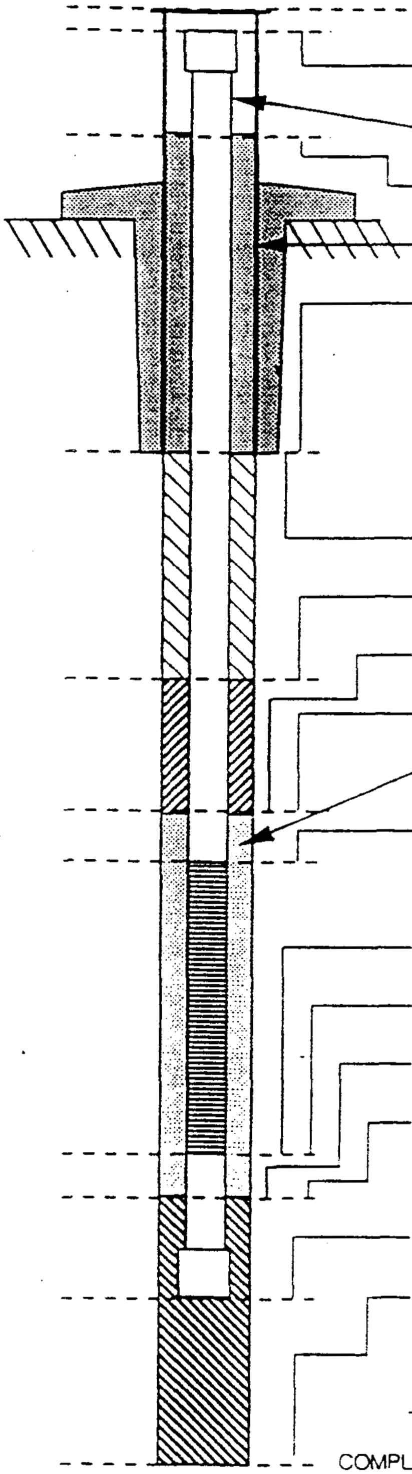
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01798
PROJECT NAME: 903 PAD/RYAN'S PIT PLUME
PROGRAM: RMRS-ER
SCREENED FORMATION: ____
DRILLING CONTRACTOR: IT / UNIVERSAL
DRILLING METHOD: geoprobe
DATE DRILLED: 4/21/98
DATE COMPLETED: 4/21/98
RIG GEOLOGIST: Jim Cox
LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 8.0
ESTIMATED DEPTH TO BEDROCK (FT): ____
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0
INITIAL WATER LEVEL (FT): DRY
DATE MEASURED: 4/22/98
COMPLETED WATER LEVEL (FT): 7.54 BGS
DATE MEASURED: 4/29/98



PROTECTIVE CASING, TOP (FT): 0.90 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.90
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): ____ TYPE: ____
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT): ____

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): ____
SECONDARY CASING, I.D. (IN): NA TYPE: ____

CENTRALIZER, O.D. (IN): NA TOP (FT): ____ BOTTOM (FT): ____
GROUT SEAL, TOP (FT): NA TYPE: ____
BENTONITE SEAL, TOP (FT): 0.0 TYPE: Gran. Bent. Hydrated w/Spring Dist. Wat
BENTONITE SEAL, BOTTOM (FT): 2.0
FILTER PACK, TOP (FT): 2.0
FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 3.0 SCREEN, TOP (FT): 3.0
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 7.8 TYPE: PVC sch 40 BRAND: ____
SUMP, TOP (FT): 7.8 TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 8.0
BACKFILL, TOP (FT): NA TYPE: ____
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 8.0
TOTAL DEPTH (FT): 8.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: ____

COMPLETED BY: Jim Cox DATE: 4/27/98
CHECKED BY: [signature] DATE: 5/11/98

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U.S. Department of Energy Rocky Flats Plant

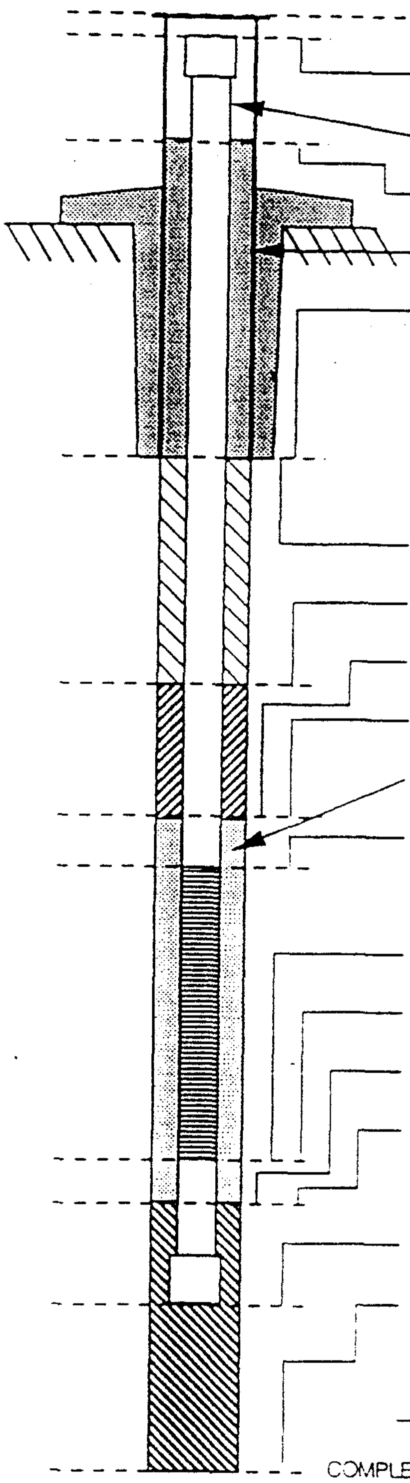
Form GT.6B
(Rev.3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01898
PROJECT NAME: 903 PAD/RYAN'S PIT PLUME
PROGRAM: RMRS-ER
SCREENED FORMATION:
DRILLING CONTRACTOR: IT / UNIVERSAL
DRILLING METHOD: geoprobe
DATE DRILLED: 4/22/98
DATE COMPLETED: 4/22/98
RIG GEOLOGIST: Jim Cox
LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 8.2
ESTIMATED DEPTH TO BEDROCK (FT):
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0

INITIAL WATER LEVEL (FT): DRY
DATE MEASURED: 4/23/98
COMPLETED WATER LEVEL (FT): DRY
DATE MEASURED: 4/24/98



PROTECTIVE CASING, TOP (FT): 0.90 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.90

SURFACE CASING, I.D. (IN): 3/4"
TYPE: PVC sch 40

SURFACE SEAL, TOP (FT):
TYPE:

PROTECTIVE CASING, I.D. (IN): 1.5"
TYPE: PVC sch 40

PROTECTIVE CASING, BOTTOM (FT):

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA
BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA
TYPE:

CENTRALIZER, O.D. (IN): NA
TOP (FT):
BOTTOM (FT):

GROUT SEAL, TOP (FT): NA
TYPE:

BENTONITE SEAL, TOP (FT): 0.0
TYPE: gran bent. Hydrated w/spring Dist. water

BENTONITE SEAL, BOTTOM (FT): 2.1

FILTER PACK, TOP (FT): 2.1

FILTER PACK TYPE: 16/40 Silica Sand
BRAND: CSS

SURFACE CASING, BOTTOM (FT): 3.2
SCREEN, TOP (FT): 3.2

SCREEN SLOT SIZE (.000 IN): 0.010
SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 8.0
TYPE: PVC sch 40
BRAND:

SUMP, TOP (FT): 8.0
TYPE: PVC sch 40 threaded end cap

FILTER PACK, BOTTOM (FT): 8.2

BACKFILL, TOP (FT): NA
TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 8.2

TOTAL DEPTH (FT): 8.2

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Jim Cox
DATE: 4/27/98

CHECKED BY: [signature]
DATE: 5-11-98

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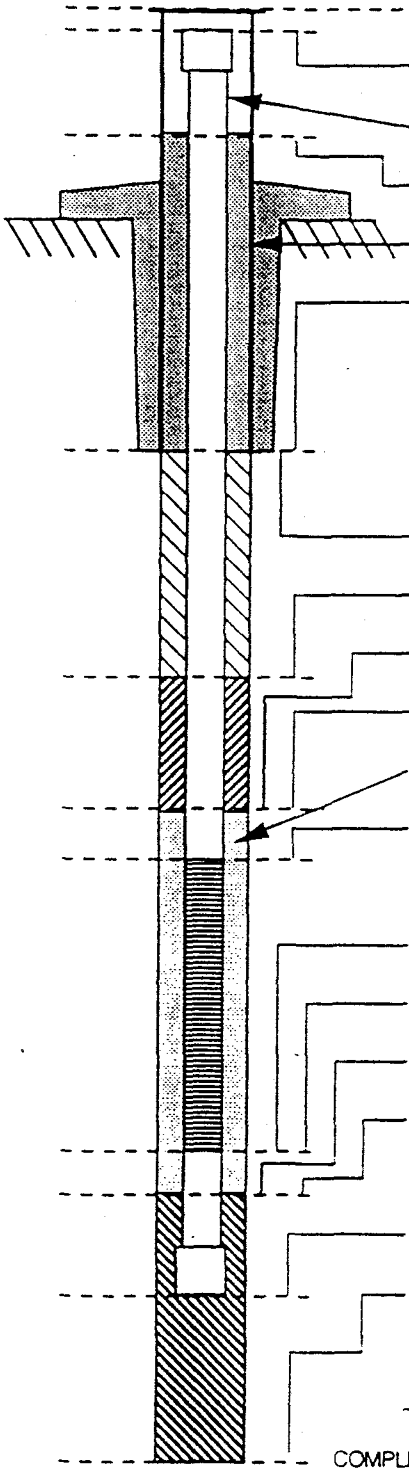
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. ~~3~~)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01998 PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER
SCREENED FORMATION: WBR/COLL. DRILLING CONTRACTOR: IT / UNIVERSAL
DRILLING METHOD: geoprobe DATE DRILLED: 4/23/98 DATE COMPLETED: 4/23/98
RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 4.5 ESTIMATED DEPTH TO BEDROCK (FT): 2.4
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0
INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 4/24/98
COMPLETED WATER LEVEL (FT): 2.25' 1345 DATE MEASURED: 4/29/98 rising



PROTECTIVE CASING, TOP (FT): 1.0 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.0
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): TYPE:
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT):

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular Bent Hydrated w/ Spray
BENTONITE SEAL, BOTTOM (FT): 1.5
FILTER PACK, TOP (FT): 1.5
FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 2.5 SCREEN, TOP (FT): 2.5
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 4.3 TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): 4.3 TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 4.5
BACKFILL, TOP (FT): 4.5 TYPE: MED. BENT PLUG
BACKFILL, BOTTOM (FT): 8.0
SUMP, BOTTOM (FT): ~~4.5~~ 4.5
TOTAL DEPTH (FT): 8.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Jim Cox DATE: 5/5/98

CHECKED BY: [signature] DATE: 5/11/98

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U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3)
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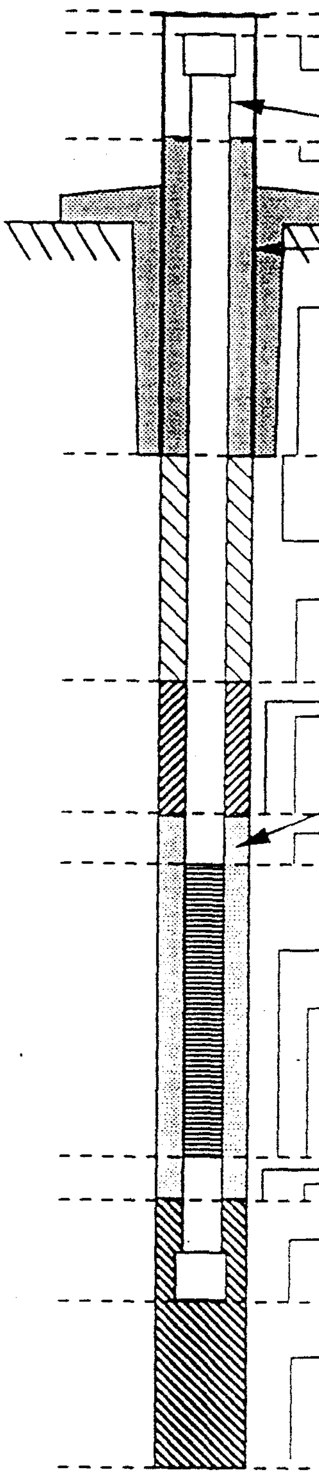
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 02098
PROJECT NAME: 903 PAD/RYAN'S PIT PLUME
PROGRAM: RMRS-ER
SCREENED FORMATION: WBR/Coll.
DRILLING CONTRACTOR: IT/UNIVERSAL
DRILLING METHOD: geoprobe
DATE DRILLED: 4/22/98
DATE COMPLETED: 4/22/98
RIG GEOLOGIST: Jim Cox
LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 4.9
ESTIMATED DEPTH TO BEDROCK (FT): 3.0
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0
INITIAL WATER LEVEL (FT): DRY
DATE MEASURED: 4/23/98
COMPLETED WATER LEVEL (FT): DRY
DATE MEASURED: 4/29/98



PROTECTIVE CASING, TOP (FT): 0.90 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.90
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): TYPE:
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT):

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular Bent Hydrated w/ Spray
BENTONITE SEAL, BOTTOM (FT): 2.0
FILTER PACK, TOP (FT): 2.0
FILTER PACK TYPE: 16/40 silica sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 2.9 SCREEN, TOP (FT): 2.9
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 4.7 TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): 4.7 TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 4.9
BACKFILL, TOP (FT): 4.9 TYPE: MED. BENT PLUG
BACKFILL, BOTTOM (FT): 6.1
SUMP, BOTTOM (FT): 4.9
TOTAL DEPTH (FT): 6.1

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Jim Cox DATE: 5/5/98
CHECKED BY: [signature] DATE: 5.11.98

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U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. ~~3~~) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 02198 PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER

SCREENED FORMATION: WBR/COLL. DRILLING CONTRACTOR: IT / UNIVERSAL

DRILLING METHOD: geoprobe DATE DRILLED: 4/13/98 DATE COMPLETED: 4/13/9

RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox

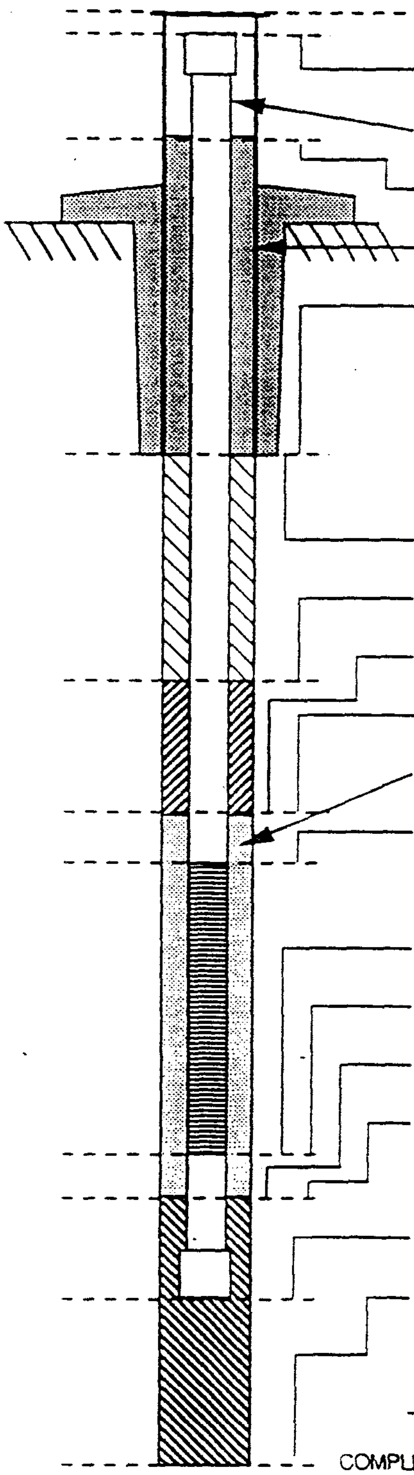
COMPLETED DEPTH (FT): 8.0 ESTIMATED DEPTH TO BEDROCK (FT): 4.5

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): ____

INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 4/14/98

COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 4/29/98



PROTECTIVE CASING, TOP (FT): 0.90 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.90

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: Gran. Bent. Hydrated w/spr...

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.80

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT): ____

SECONDARY CASING, I.D. (IN): NA TYPE: ____

CENTRALIZER, O.D. (IN): NA TOP (FT): ____ BOTTOM (FT): ____

GROUT SEAL, TOP (FT): NA TYPE: ____

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular Bent. Hydrated w/ spray

BENTONITE SEAL, BOTTOM (FT): 2.0

FILTER PACK, TOP (FT): 2.0

FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS

SURFACE CASING, BOTTOM (FT): 3.0 SCREEN, TOP (FT): 3.0

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): ~~11.8~~ 7.8 TYPE: PVC sch 40 BRAND: ____

SUMP, TOP (FT): ~~11.8~~ 7.8 TYPE: PVC sch 40 threaded end cap

FILTER PACK, BOTTOM (FT): ~~12.0~~ 8.0

BACKFILL, TOP (FT): ~~NA~~ 8.0 TYPE: Bentonite Plug (Chip) NOT Hydrated.

BACKFILL, BOTTOM (FT): JC ~~NA~~ 12.0

SUMP, BOTTOM (FT): ~~12.0~~ 8.0 JC

TOTAL DEPTH (FT): 12.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: ____

COMPLETED BY: Jim Cox DATE: 4/15/98

CHECKED BY: [signature] DATE: 5-11-98

~~510~~ 508

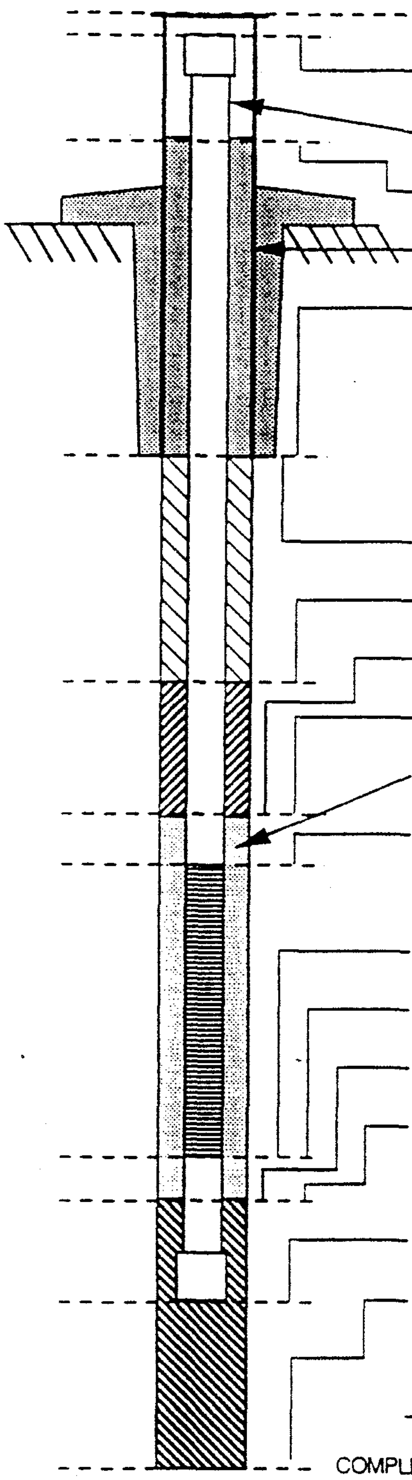
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. ~~3~~)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 02298
PROJECT NAME: 903 PAD/RYAN'S PIT PLUME
PROGRAM: RMRS - ER
SCREENED FORMATION: Weathered BE/Alluvium Colluvium
DRILLING CONTRACTOR: IT Corp / Universal
DRILLING METHOD: Geoprobe
DATE DRILLED: 4/10/98
DATE COMPLETED: 4/10/98
RIG GEOLOGIST: Jim Cox
LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): ~~8.2~~ 8.3
ESTIMATED DEPTH TO BEDROCK (FT): 4.6
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0
INITIAL WATER LEVEL (FT): DRY
DATE MEASURED: 4/~~11~~ 13 (JC)/98
COMPLETED WATER LEVEL (FT): DRY
DATE MEASURED: 4/29/98



PROTECTIVE CASING, TOP (FT): 1.0 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.0

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40

SURFACE SEAL, TOP (FT): 0.0 TYPE: gran. bent. hydrated w/ spray

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40

PROTECTIVE CASING, BOTTOM (FT): 0.7

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.0 TYPE: gran bent. hydrated w/ spray distilled water

BENTONITE SEAL, BOTTOM (FT): 2.3'

FILTER PACK, TOP (FT): 2.3'

FILTER PACK TYPE: 16/40 silica sand BRAND: CSS

SURFACE CASING, BOTTOM (FT): 3.3' SCREEN, TOP (FT): 3.3'

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): ~~8.3~~ 8.1 TYPE: PVC sch 40 BRAND:

SUMP, TOP (FT): 8.1 TYPE: PVC sch 40 threaded end cap

FILTER PACK, BOTTOM (FT): 8.3

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 8.3

TOTAL DEPTH (FT): 8.3

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Jim Cox DATE: 4/10/98

CHECKED BY: DATE: 5.1.98

SH 509

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 03198 PROJECT NAME: SPPRP PROGRAM: NA

SCREENED FORMATION: UHSU/bedrock DRILLING CONTRACTOR: TEG

DRILLING METHOD: geoprobe DATE DRILLED: 2/12/98 DATE COMPLETED: 2/12/98

RIG GEOLOGIST: Tim Lovseth LOGGING GEOLOGIST: Tim Lovseth

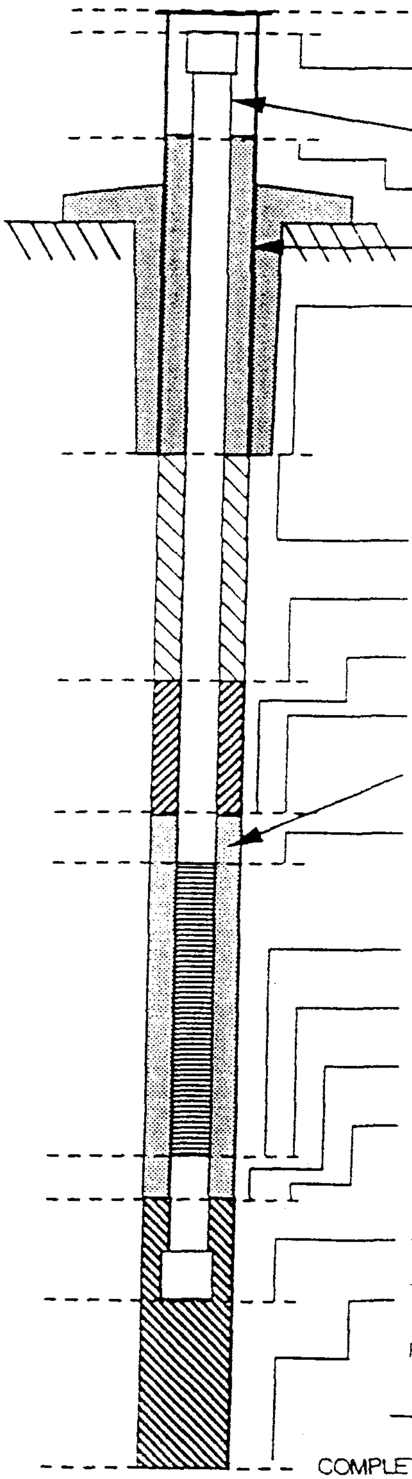
COMPLETED DEPTH (FT): 12 ESTIMATED DEPTH TO BEDROCK (FT): 7.8

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 3/4 ID, 2 in borehole

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): None

INITIAL WATER LEVEL (FT): ______ DATE MEASURED: ______

COMPLETED WATER LEVEL (FT): ______ DATE MEASURED: ______



PROTECTIVE CASING, TOP (FT): .5 Ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): .5 Ft

SURFACE CASING, I.D. (IN): 3/4 in TYPE: Sch 80

SURFACE SEAL TOP (FT): None TYPE: —

PROTECTIVE CASING, I.D. (IN): 2 TYPE: Sch 40 PVC

PROTECTIVE CASING, BOTTOM (FT): .5 Ft

IF APPLICABLE SECONDARY CASING, TOP (FT): None BOTTOM (FT): ______

SECONDARY CASING, I.D. (IN): None TYPE: ______

CENTRALIZER, O.D. (IN): NA TOP (FT): ______ BOTTOM (FT): ______

GROUT SEAL TOP (FT): None TYPE: —

BENTONITE SEAL, TOP (FT): 0 TYPE: Wyoming granular bentonite

BENTONITE SEAL, BOTTOM (FT): 5.75

FILTER PACK, TOP (FT): 5.75

FILTER PACK TYPE: Colorado Silica Sand BRAND: 16-40 CSSI

SURFACE CASING, BOTTOM (FT): 7.0 SCREEN, TOP (FT): 7.0

SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 3/4

SCREEN, BOTTOM (FT): 12.0 TYPE: Sch 80 BRAND: Geoprobe Systems

SUMP, TOP (FT): None TYPE: —

FILTER PACK, BOTTOM (FT): 12.0

BACKFILL, TOP (FT): None TYPE: —

BACKFILL, BOTTOM (FT): None

SUMP, BOTTOM (FT): None

TOTAL DEPTH (FT): 12.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: expendable well point @ 12.0

COMPLETED BY: T.P. Lovseth DATE: 2/12/98

CHECKED BY: ______ DATE: ______

~~517~~ 510

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
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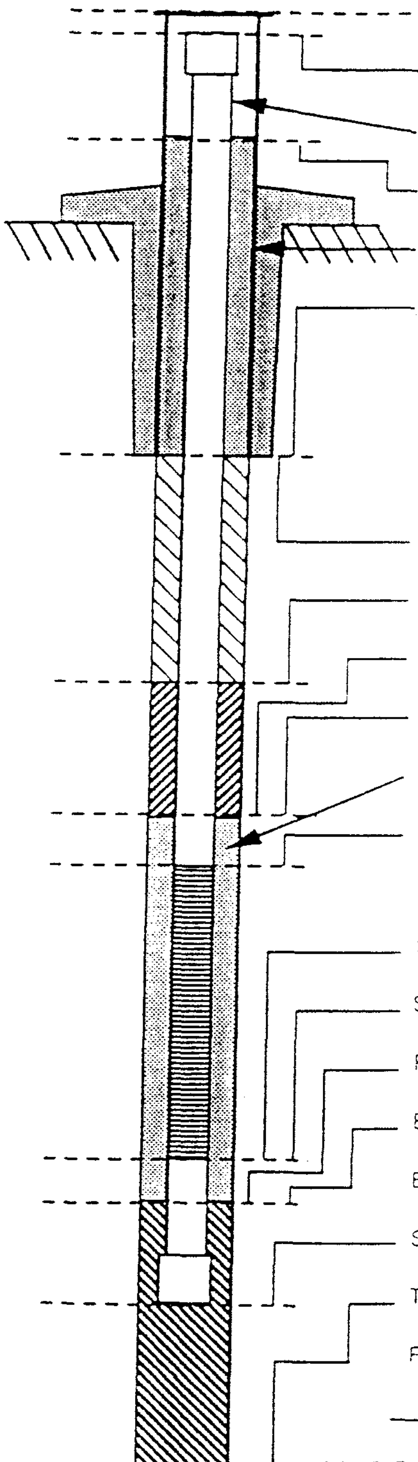
Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 03298 PROJECT NAME: SPPRP PROGRAM: NA
SCREENED FORMATION: Alluvium/Bedrock DRILLING CONTRACTOR: TEG
DRILLING METHOD: geoprobe DATE DRILLED: 2/12 - 2/13/98 DATE COMPLETED: 2/13/98
RIG GEOLOGIST: Tim Louseth LOGGING GEOLOGIST: Tim Louseth
COMPLETED DEPTH (FT): 25 ESTIMATED DEPTH TO BEDROCK (FT): 23
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN):

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): None
INITIAL WATER LEVEL (FT): DATE MEASURED:
COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): .5 ft (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): .5 ft
SURFACE CASING, I.D. (IN): 3/4 in TYPE: Sch 80
SURFACE SEAL, TOP (FT): none TYPE:
PROTECTIVE CASING, I.D. (IN): 2 TYPE: Sch 40 PVC
PROTECTIVE CASING, BOTTOM (FT): .5 ft
IF APPLICABLE SECONDARY CASING, TOP (FT): none BOTTOM (FT):
SECONDARY CASING, I.D. (IN): none TYPE:
CENTRALIZER, O.D. (IN): none TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): none TYPE: —
BENTONITE SEAL, TOP (FT): 0 TYPE: Wyoming granular bentonite
BENTONITE SEAL, BOTTOM (FT): 18
FILTER PACK, TOP (FT): 18
FILTER PACK TYPE: 16-40 BRAND: Colorado Silica Sand
SURFACE CASING, BOTTOM (FT): 20 SCREEN, TOP (FT): 20
SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 3/4 in
SCREEN, BOTTOM (FT): 25 TYPE: Sch 80 BRAND: Geoprobe Systems
SUMP, TOP (FT): none TYPE:
FILTER PACK, BOTTOM (FT): 25
BACKFILL, TOP (FT): none TYPE:
BACKFILL, BOTTOM (FT): none
SUMP, BOTTOM (FT): None
TOTAL DEPTH (FT): 25

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: expendable well pt @ 25.0

COMPLETED BY: T.F. Louseth DATE: 2/13/98

CHECKED BY: DATE:

~~515~~ 511

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. ~~3~~)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 03398 PROJECT NAME: Solar Ponds Plume PROGRAM: NA

SCREENED FORMATION: Alluvium/Bedrock DRILLING CONTRACTOR: TEG

DRILLING METHOD: Geoprobe DATE DRILLED: 2/17/98 DATE COMPLETED: 2/17/98

RIG GEOLOGIST: Tim Lovseth LOGGING GEOLOGIST: Tim Lovseth

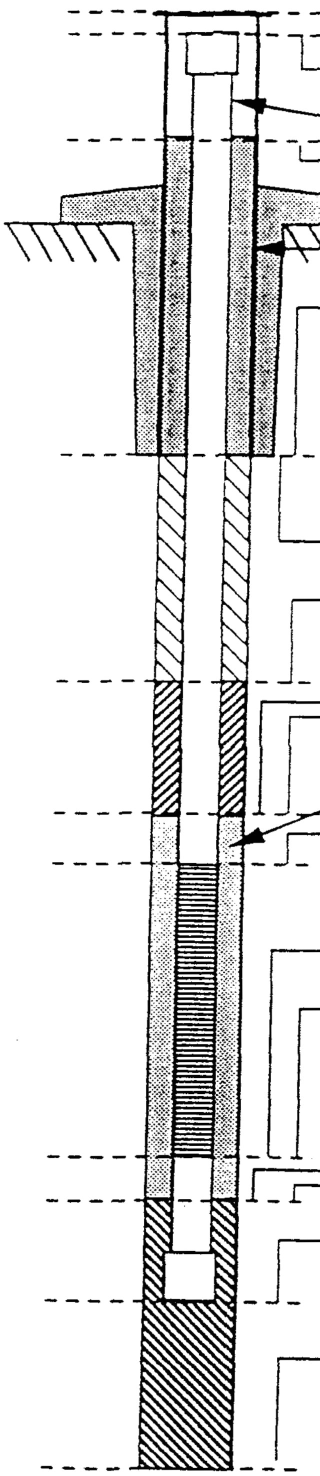
COMPLETED DEPTH (FT): 19 ESTIMATED DEPTH TO BEDROCK (FT): 16.5

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL):

INITIAL WATER LEVEL (FT): DATE MEASURED:

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): .5 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): .5

SURFACE CASING, I.D. (IN): 3/4 TYPE: Sch 80

SURFACE SEAL, TOP (FT): none TYPE:

PROTECTIVE CASING, I.D. (IN): 2 TYPE: Sch 40

PROTECTIVE CASING, BOTTOM (FT): 5

IF APPLICABLE SECONDARY CASING, TOP (FT): na BOTTOM (FT):

SECONDARY CASING, I.D. (IN): none TYPE:

CENTRALIZER, O.D. (IN): none TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): none TYPE:

BENTONITE SEAL, TOP (FT): 0 TYPE: Wyoming Bentonite

BENTONITE SEAL, BOTTOM (FT): 12

FILTER PACK, TOP (FT): ~~14~~ 12

FILTER PACK TYPE: 16-40 BRAND: Colorado Silica Sand

SURFACE CASING, BOTTOM (FT): 14 SCREEN, TOP (FT): 14

SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 3/4

SCREEN, BOTTOM (FT): 19 TYPE: Sch 80 BRAND: Geoprobe

SUMP, TOP (FT): none TYPE:

FILTER PACK, BOTTOM (FT): 19

BACKFILL, TOP (FT): none TYPE:

BACKFILL, BOTTOM (FT): none

SUMP, BOTTOM (FT): none

TOTAL DEPTH (FT): 19

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: [signature] DATE: 2/17/98

CHECKED BY: DATE:

SW 512

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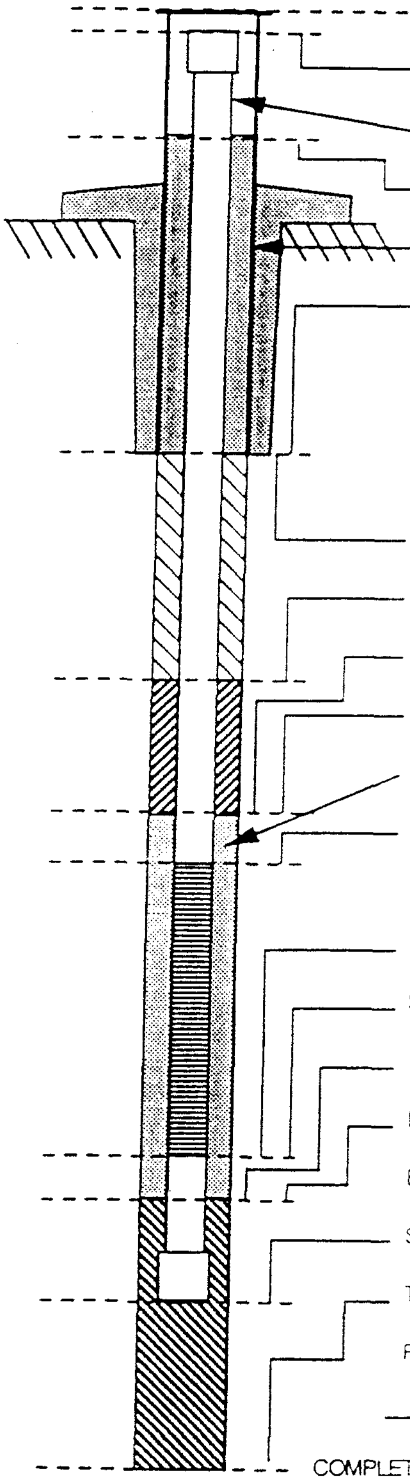
Form GT.6B
(Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 03495 PROJECT NAME: Solar Ponds Plume PROGRAM: NA
SCREENED FORMATION: Alluvium/Bedrock DRILLING CONTRACTOR: IEG
DRILLING METHOD: Geoprobe DATE DRILLED: 2/17-2/18/98 DATE COMPLETED: 2/18/98
RIG GEOLOGIST: Tim Lovseth LOGGING GEOLOGIST: Tim Lovseth
COMPLETED DEPTH (FT): 16 ESTIMATED DEPTH TO BEDROCK (FT): 13 Ft
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 3/4

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): DATE MEASURED:
COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): .5 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): .5
SURFACE CASING, I.D. (IN): 3/4 TYPE: Sch 80
SURFACE SEAL, TOP (FT): none TYPE:
PROTECTIVE CASING, I.D. (IN): 2 TYPE: 2" sch 40 Pvc
PROTECTIVE CASING, BOTTOM (FT):

IF APPLICABLE
SECONDARY CASING, TOP (FT): none BOTTOM (FT):
SECONDARY CASING, I.D. (IN): none TYPE:

CENTRALIZER, O.D. (IN): none TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): none TYPE:
BENTONITE SEAL, TOP (FT): 0 TYPE: Wyoming Bentonite
BENTONITE SEAL, BOTTOM (FT): 10
FILTER PACK, TOP (FT): 10
FILTER PACK TYPE: 16-40 BRAND: Colorado Silica Sand
SURFACE CASING, BOTTOM (FT): 11 SCREEN, TOP (FT): 11
SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 3/4
SCREEN, BOTTOM (FT): 16 TYPE: Sch 80 BRAND: Geoprobe Systems
SUMP, TOP (FT): none TYPE:
FILTER PACK, BOTTOM (FT): 16
BACKFILL, TOP (FT): none TYPE:
BACKFILL, BOTTOM (FT): none
SUMP, BOTTOM (FT): none
TOTAL DEPTH (FT): 16

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: [signature] DATE: 2/18/98
CHECKED BY: DATE:

SS 513

NEW WELL ID# 03998

U.S. Department of Energy Rocky Flats Plant

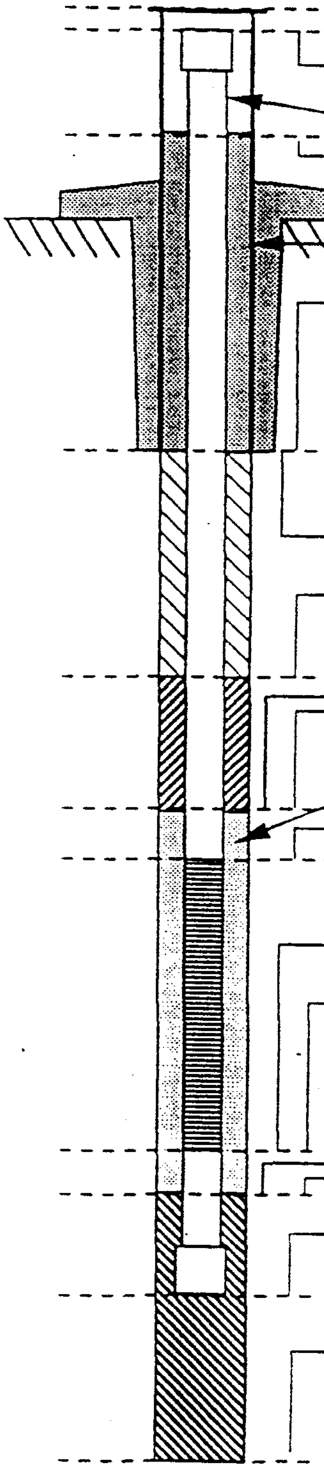
Form GT.6B
(Rev. ~~3~~)
ORR 3/31/94

JC 5/29/98

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 03198 PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER
SCREENED FORMATION: WBR / Colluvium DRILLING CONTRACTOR: IT / UNIVERSAL
DRILLING METHOD: geoprobe DATE DRILLED: 4/23/98 DATE COMPLETED: 4/23/98
RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 8.0 ESTIMATED DEPTH TO BEDROCK (FT): 8.0
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0
INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 4/27/98
COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 4/28/98



PROTECTIVE CASING, TOP (FT): 1.0 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.0
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): TYPE:
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT):
IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:
CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular Bent. Hydrated w/spray
BENTONITE SEAL, BOTTOM (FT): 2.0
FILTER PACK, TOP (FT): 2.0
FILTER PACK TYPE: 16/40 Silica Sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 3.0 SCREEN, TOP (FT): 3.0
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 7.8 TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): 7.8 TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 8.0
BACKFILL, TOP (FT): 8.0 TYPE: MED. BENT. PLUG
BACKFILL, BOTTOM (FT): 10.0
SUMP, BOTTOM (FT): 8.0
TOTAL DEPTH (FT): 10.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Jim Cox DATE: 5/5/98
CHECKED BY: [signature] DATE: 5.11.98

SW 514

NEW WELL-ID# 04098

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. ~~3~~)
ORR 3/31/94

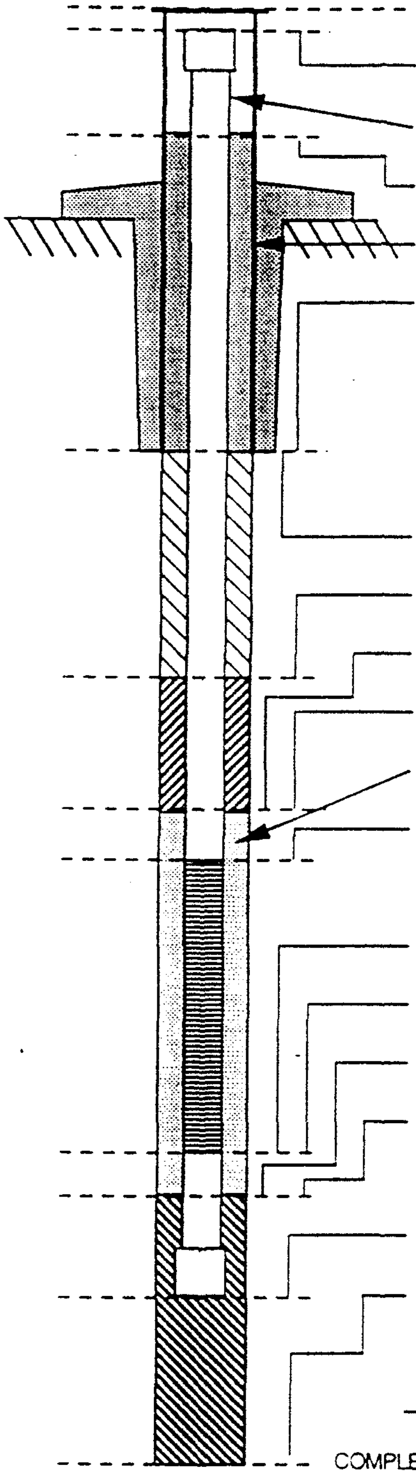
JC 5/29/98

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 03298 PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER
SCREENED FORMATION: ______ DRILLING CONTRACTOR: IT / UNIVERSAL
DRILLING METHOD: geoprobe DATE DRILLED: ______ DATE COMPLETED: ______
RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 7.9 ESTIMATED DEPTH TO BEDROCK (FT): ______
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0

INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 4/27/98
COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 4/28/98



PROTECTIVE CASING, TOP (FT): 1.0 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 1.0
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): ______ TYPE: ______
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT): ______

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT): ______
SECONDARY CASING, I.D. (IN): NA TYPE: ______

CENTRALIZER, O.D. (IN): NA TOP (FT): ______ BOTTOM (FT): ______
GROUT SEAL, TOP (FT): NA TYPE: ______
BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular Bent Hydrated w/ spray
BENTONITE SEAL, BOTTOM (FT): 2.0
FILTER PACK, TOP (FT): 2.0
FILTER PACK TYPE: 16/40 silica sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 2.9 SCREEN, TOP (FT): 2.9
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 7.7 TYPE: PVC sch 40 BRAND: ______
SUMP, TOP (FT): ~~2.7~~ 7.7 TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 7.9
BACKFILL, TOP (FT): 7.9 TYPE: BENT. PLUG MED
BACKFILL, BOTTOM (FT): 14.1
SUMP, BOTTOM (FT): 7.9
TOTAL DEPTH (FT): 14.1

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: ______

COMPLETED BY: Jim Cox DATE: 5/5/98

CHECKED BY: [signature] DATE: 5.11.98

SH-816515

NEW WELL ID # 04198

JL 5/29/98

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: ~~C3376~~ C3398 PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER

SCREENED FORMATION: ______ DRILLING CONTRACTOR: IT / UNIVERSAL

DRILLING METHOD: geoprobe DATE DRILLED: 4/27/98 DATE COMPLETED: 4/27/98

RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox

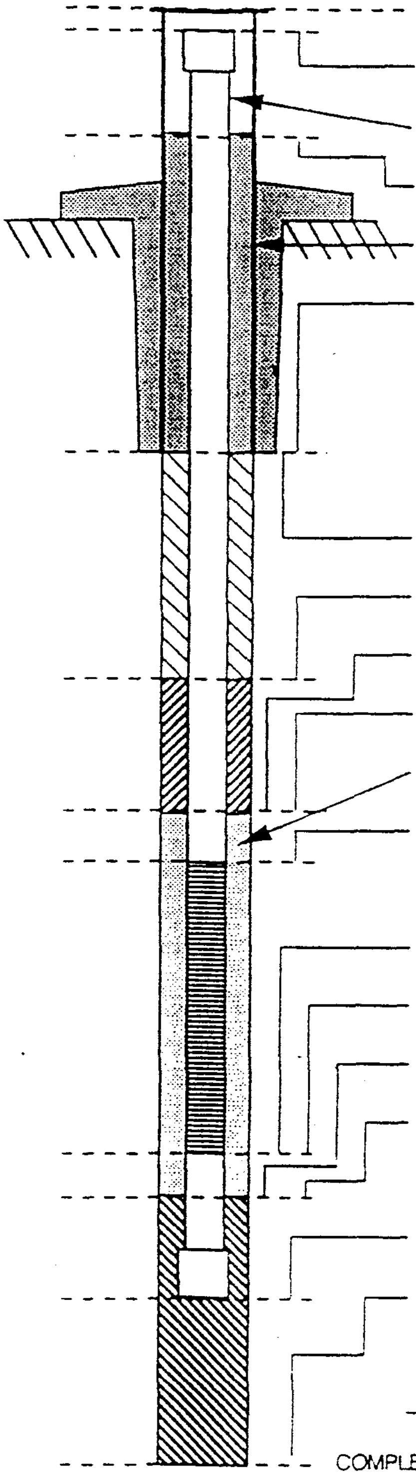
COMPLETED DEPTH (FT): 13.0 ESTIMATED DEPTH TO BEDROCK (FT): ______

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0

INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 4/27/98

COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 4/29/98



PROTECTIVE CASING, TOP (FT): 1.0 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 1.0

SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40

SURFACE SEAL, TOP (FT): ______ TYPE: ______

PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40

PROTECTIVE CASING, BOTTOM (FT): ______

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT): ______

SECONDARY CASING, I.D. (IN): NA TYPE: ______

CENTRALIZER, O.D. (IN): NA TOP (FT): ______ BOTTOM (FT): ______

GROUT SEAL, TOP (FT): NA TYPE: ______

BENTONITE SEAL, TOP (FT): 0.0 TYPE: Granular Bent. Hydrated w/spray

BENTONITE SEAL, BOTTOM (FT): 6.9

FILTER PACK, TOP (FT): 6.9

FILTER PACK TYPE: 16/40 silica sand BRAND: CSS

SURFACE CASING, BOTTOM (FT): 8.0 SCREEN, TOP (FT): 8.0

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"

SCREEN, BOTTOM (FT): 12.8 TYPE: PVC sch 40 BRAND: ______

SUMP, TOP (FT): 12.8 TYPE: PVC sch 40 threaded end cap

FILTER PACK, BOTTOM (FT): 13.0

BACKFILL, TOP (FT): 13.0 TYPE: Bent. Plug. MED

BACKFILL, BOTTOM (FT): 18.1

SUMP, BOTTOM (FT): 13.0

TOTAL DEPTH (FT): 18.1

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: ______

COMPLETED BY: Jim Cox DATE: 5/5/98

CHECKED BY: [signature] DATE: 5.11.98

~~518~~ 516

NEW WELL ID # 04298
JC 5/29/98

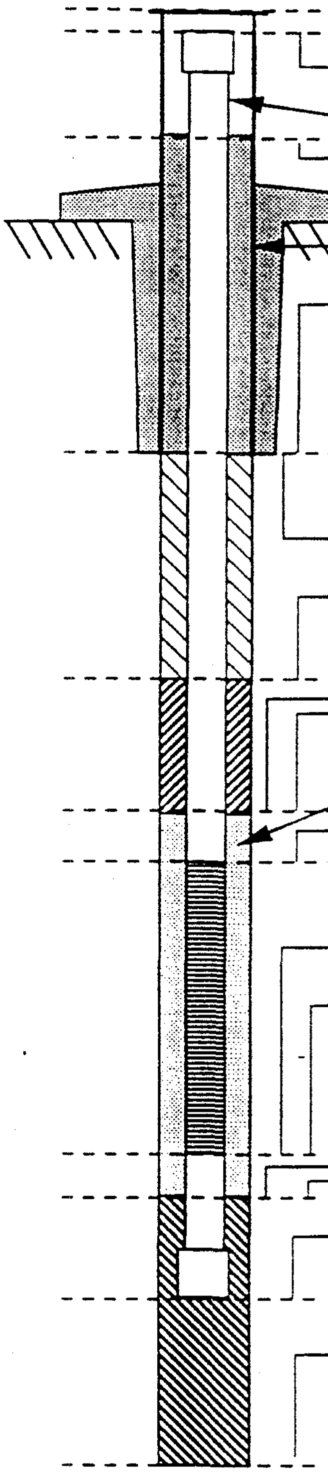
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 01198A PROJECT NAME: 903 PAD/RYAN'S PIT PLUME PROGRAM: RMRS-ER
SCREENED FORMATION: COLLUVIUM/SOIL DRILLING CONTRACTOR: IT/UNIVERSAL
DRILLING METHOD: Geoprobe DATE DRILLED: 4/9/98 DATE COMPLETED: 4/9/98
RIG GEOLOGIST: Jim Cox LOGGING GEOLOGIST: Jim Cox
COMPLETED DEPTH (FT): 6.0 ESTIMATED DEPTH TO BEDROCK (FT): 18.8
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2.0"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): 0
INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 4/10/98
COMPLETED WATER LEVEL (FT): DRY DATE MEASURED: 4/29/98



PROTECTIVE CASING, TOP (FT): 0.90 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.90
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC sch 40
SURFACE SEAL, TOP (FT): 0.0 TYPE: gran. bent hydrated w/spray
PROTECTIVE CASING, I.D. (IN): 1.5" TYPE: PVC sch 40
PROTECTIVE CASING, BOTTOM (FT): 0.80

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.0 TYPE: granular bent hydrated w/spray
BENTONITE SEAL, BOTTOM (FT): 2.9
FILTER PACK, TOP (FT): 2.9
FILTER PACK TYPE: 16/40 silica sand BRAND: CSS
SURFACE CASING, BOTTOM (FT): 4.0 SCREEN, TOP (FT): 4.0
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 5.8 TYPE: PVC sch 40 BRAND:
SUMP, TOP (FT): 5.8 TYPE: PVC sch 40 threaded end cap
FILTER PACK, BOTTOM (FT): 6.0
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 6.0
TOTAL DEPTH (FT): 6.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: partner well to 01198

COMPLETED BY: Jim Cox DATE: 4/9/98
CHECKED BY: [signature] DATE: 5.11.98

SH 517

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. ~~3~~) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10098 PROJECT NAME: BLDG. 123 PROGRAM: GROUNDWATER

SCREENED FORMATION: ALLUVIUM DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE DATE DRILLED: 7/30-31/98 DATE COMPLETED: 7/31/98

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: —

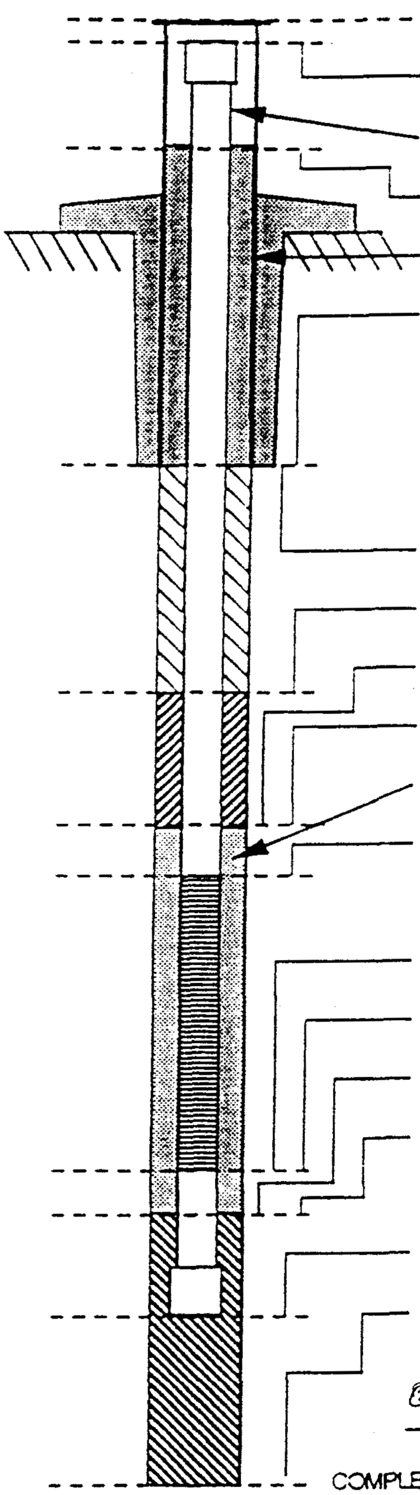
COMPLETED DEPTH (FT): ~~9.0~~ 8.8 ESTIMATED DEPTH TO BEDROCK (FT): NOT PENETRATED

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): 3.38 DATE MEASURED: 7/31/98

COMPLETED WATER LEVEL (FT): 4.44 DATE MEASURED: 8/3/98



PROTECTIVE CASING, TOP (FT): 0.0 (FROM GROUND SURFACE) FLUSH MOUNT

SURFACE CASING (STICKUP), TOP (FT): 0.5 below ground

SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC

SURFACE SEAL, TOP (FT): ~0.7 below ground TYPE: concrete

PROTECTIVE CASING, I.D. (IN): 8 TYPE: STEEL MANHOLE SKIRT

PROTECTIVE CASING, BOTTOM (FT): 1.0

IF APPLICABLE SECONDARY CASING, TOP (FT): 0.2 below ground BOTTOM (FT): 1.5

SECONDARY CASING, I.D. (IN): 2.0 TYPE: Sch 40 PVC

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:

BENTONITE SEAL, TOP (FT): 1.0 TYPE: GRANULAR BENTONITE

BENTONITE SEAL, BOTTOM (FT): ~~2.87~~ 2.9

FILTER PACK, TOP (FT): 2.9

FILTER PACK TYPE: 16/40 SILICA SAND BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 3.8 (3.77) SCREEN, TOP (FT): 3.8 (3.77)

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75

SCREEN, BOTTOM (FT): 8.65 TYPE: SCH 40 PVC BRAND:

SUMP, TOP (FT): 8.65 TYPE: THREADED END-CAP (NOT TRUE SUMP)

FILTER PACK, BOTTOM (FT): 9.0

BACKFILL, TOP (FT): 9.0 TYPE: NATIVE MATERIALS

BACKFILL, BOTTOM (FT): 11.0

SUMP, BOTTOM (FT): 8.8

TOTAL DEPTH (FT): 11.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: (1) SECONDARY CASING INSTALLED TO ENABLE USE OF 2" LOCKING J-

(2) HOLE COLLAPSED BELOW 8.8'.

COMPLETED BY: T. LUTHERER / J. BOYLAN DATE: 7/31/98

CHECKED BY: DATE:

~~500~~ 518

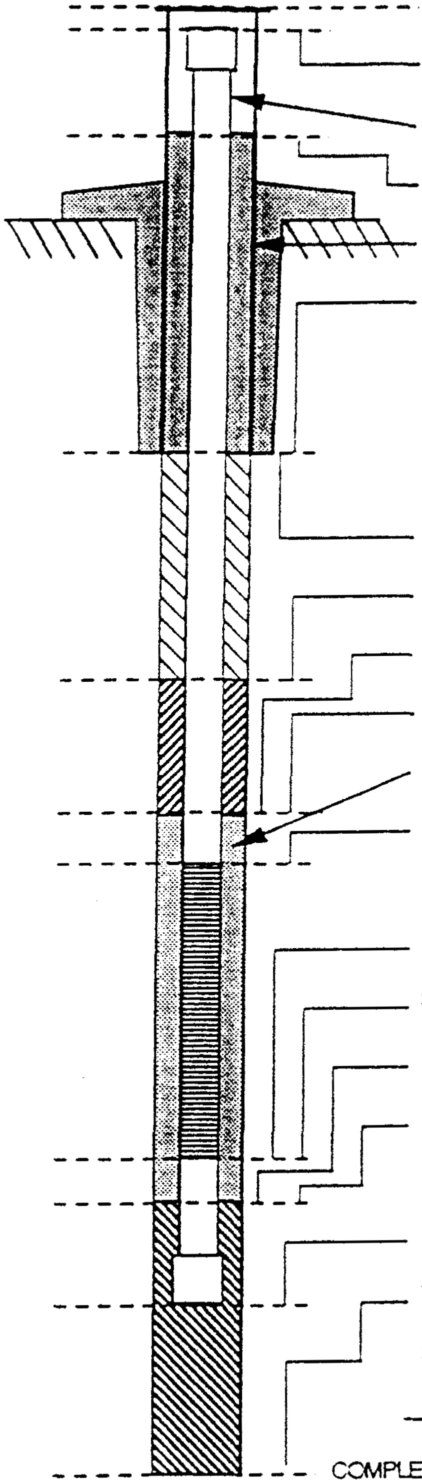
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10198 PROJECT NAME: BLDG. 123 PROGRAM: GROUNDWATER
SCREENED FORMATION: ALLUVIUM DRILLING CONTRACTOR: TIERRA
DRILLING METHOD: GEOPROBE DATE DRILLED: 8/10/98 DATE COMPLETED: 8/14/98
RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: —
COMPLETED DEPTH (FT): 13.2 ESTIMATED DEPTH TO BEDROCK (FT): NOT PENETRATED
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 8/10/98
COMPLETED WATER LEVEL (FT): 12.69 DATE MEASURED: 8/13/98



PROTECTIVE CASING, TOP (FT): 0.0 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.5 below ground FLUSH MOUNT
SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC
SURFACE SEAL, TOP (FT): ~0.6 below ground TYPE: CONCRETE
PROTECTIVE CASING, I.D. (IN): 8 TYPE: STEEL MANHOLE SKIRT
PROTECTIVE CASING, BOTTOM (FT): 1.0
IF APPLICABLE SECONDARY CASING, TOP (FT): 0.2 BOTTOM (FT):
SECONDARY CASING, I.D. (IN): 2.0 TYPE: Sch 40 PVC
CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): 1.95 TYPE: GRANULAR BENTONITE
BENTONITE SEAL, BOTTOM (FT): 4.9
FILTER PACK, TOP (FT): 4.9
FILTER PACK TYPE: 16/40 SILICA SAND BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 5.26 SCREEN, TOP (FT): 5.26
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 13.06 TYPE: Sch 40 PVC BRAND:
SUMP, TOP (FT): 13.06 TYPE: THREADED END-CAP (NOT TRUE SUMP)
FILTER PACK, BOTTOM (FT): 13.21
BACKFILL, TOP (FT): 13.21 TYPE: NATIVE MATERIALS
BACKFILL, BOTTOM (FT): 13.3
SUMP, BOTTOM (FT): 13.21
TOTAL DEPTH (FT): 13.3

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: ① SECONDARY CASING INSTALLED TO ENABLE USE OF 2" LOCKING J-CAP.

COMPLETED BY: J BOYLAN DATE: 8/10/98

CHECKED BY: DATE:

SDT 519

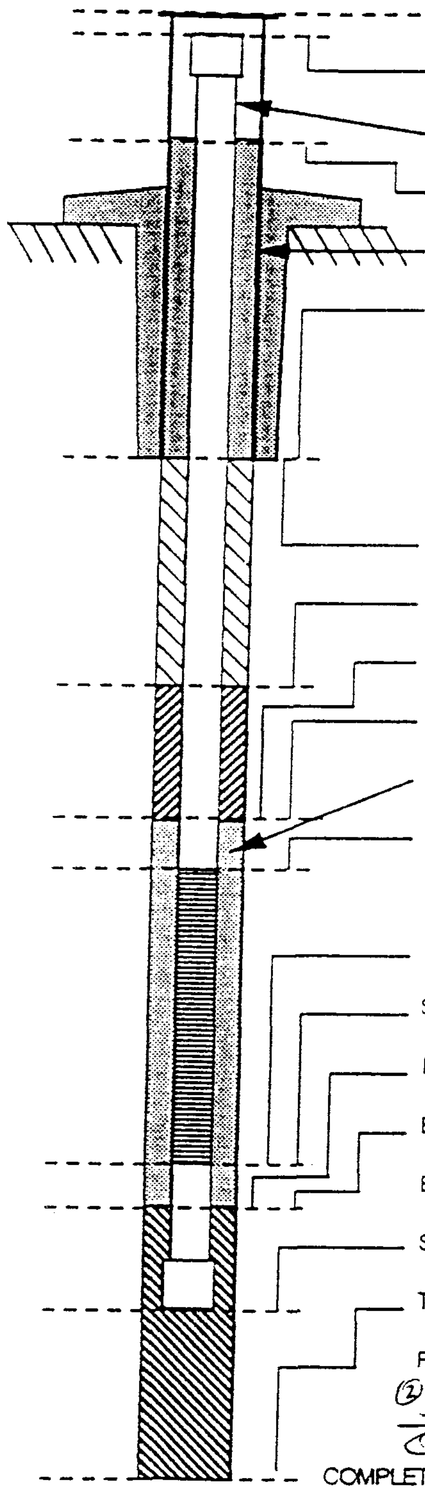
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10298 PROJECT NAME: BLDG. 123 PROGRAM: GROUNDWATER
SCREENED FORMATION: ALLUVIUM DRILLING CONTRACTOR: TIERRA
DRILLING METHOD: GEOPROBE DATE DRILLED: 8/4-5/98 DATE COMPLETED: 8/5/98
RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: ——
COMPLETED DEPTH (FT): 15.66 ESTIMATED DEPTH TO BEDROCK (FT): NOT PENETRATED
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 8/5/98
COMPLETED WATER LEVEL (FT): 6.73 DATE MEASURED: 8/11/98



PROTECTIVE CASING, TOP (FT): 0.0 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.6 below ground FLUSH MOUNT
SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC
SURFACE SEAL, TOP (FT): 0.7 below ground TYPE: CONCRETE
PROTECTIVE CASING, I.D. (IN): 8 TYPE: STEEL MANHOLE SKIRT
PROTECTIVE CASING, BOTTOM (FT): 1.0
IF APPLICABLE SECONDARY CASING, TOP (FT): 0.3 BOTTOM (FT): 1.6
SECONDARY CASING, I.D. (IN): 2.0 TYPE: Sch 40 PVC
CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): 1.1 TYPE: GRANULAR BENTONITE
BENTONITE SEAL, BOTTOM (FT): 3.8
FILTER PACK, TOP (FT): 3.8
FILTER PACK TYPE: 16/40 SILICA SAND BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 5.84 SCREEN, TOP (FT): 5.84
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 15.6 TYPE: SCH 40 PVC BRAND:
SUMP, TOP (FT): 15.6 TYPE: THREADED END-CAP (NOT TRUE SUMP)
FILTER PACK, BOTTOM (FT): 15.66
BACKFILL, TOP (FT): 15.66 TYPE: NATIVE MATERIALS
BACKFILL, BOTTOM (FT): 16.0
SUMP, BOTTOM (FT): 15.66
TOTAL DEPTH (FT): 16.0

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: ① SECONDARY CASING INSTALLED TO ENABLE USE OF 2" LOCKING J-CAP
② BOREHOLE ~~WELL~~ COLLAPSED BELOW 15.66'. JAB

COMPLETED BY: J. BOYLAN DATE: 8/5/98

CHECKED BY: DATE:

SCC 520

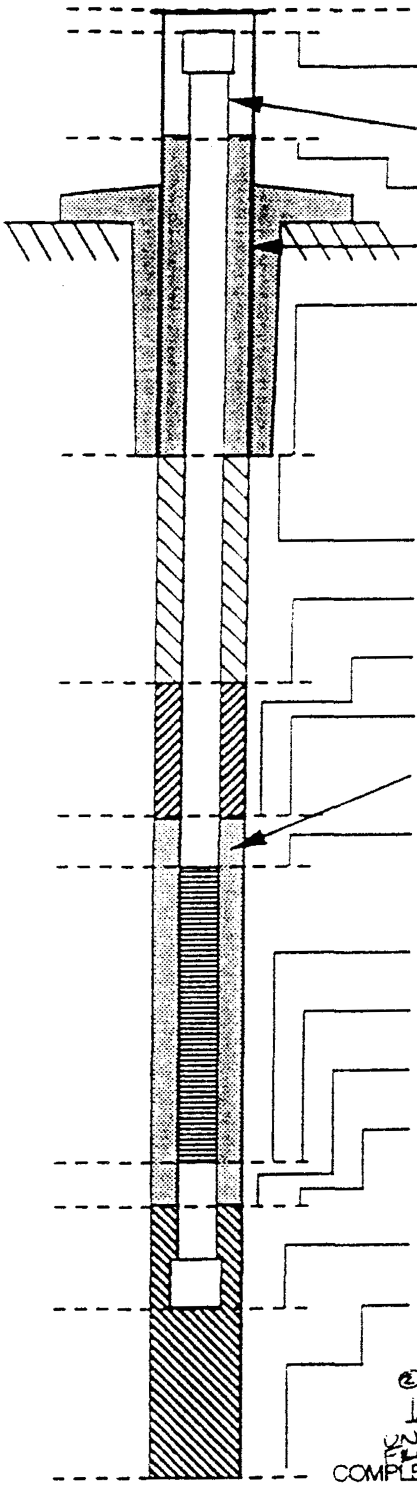
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10348 PROJECT NAME: BLDG. 123 PROGRAM: GROUNDWATER
SCREENED FORMATION: ALLUVIUM DRILLING CONTRACTOR: TIERRA
DRILLING METHOD: GEOPROBE DATE DRILLED: 8/11/98 DATE COMPLETED: 8/13/98
RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: —
COMPLETED DEPTH (FT): 11.26 ESTIMATED DEPTH TO BEDROCK (FT): NOT PENETRATED
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): DRY DATE MEASURED: 8/11/98
COMPLETED WATER LEVEL (FT): 8.25 DATE MEASURED: 8/17/98



PROTECTIVE CASING, TOP (FT): 0.0 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.5 below ground FLUSH MOUNT
SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC
SURFACE SEAL, TOP (FT): ~0.7 TYPE: CONCRETE
PROTECTIVE CASING, I.D. (IN): 8 TYPE: STEEL MANHOLE SKIRT
PROTECTIVE CASING, BOTTOM (FT): 1.0

IF APPLICABLE
SECONDARY CASING, TOP (FT): 0.3 BOTTOM (FT):
SECONDARY CASING, I.D. (IN): 2.0 TYPE: Sch 40 PVC

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): 2.1 * SEE NOTE (3) TYPE: GRANULAR BENTONITE
BENTONITE SEAL, BOTTOM (FT): 4.75
FILTER PACK, TOP (FT): 4.75
FILTER PACK TYPE: 16/40 SILICA SAND BRAND: CSS1
SURFACE CASING, BOTTOM (FT): 5.31 SCREEN, TOP (FT): 5.31
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 11.11 TYPE: Sch 40 PVC BRAND:
SUMP, TOP (FT): 11.11 TYPE: THREADED END-CAP (NOT TRUE SUMP)
FILTER PACK, BOTTOM (FT): 11.26
BACKFILL, TOP (FT): N/A TYPE:
BACKFILL, BOTTOM (FT): N/A
SUMP, BOTTOM (FT): 11.26
TOTAL DEPTH (FT): 11.26

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: (1) SECONDARY CASING INSTALLED TO ENABLE USE OF 2" LOCKING J-CAP. (2) WELL INSTALLED IN 5TH ATTEMPTED BOREHOLE (SHALLOW REFUSAL IN PREVIOUS 4). (3) OBSERV UNUSUAL GROUND CONDITIONS AT FINAL LOC'N: NEAR-REFUSAL @ 1.4', THEN LURCHED TO 2.1', UNABLE T FILL W/BENTONITE ABOVE 2.1' — INDICATES VOID IS PRESENT. HOWEVER, CORE SHOWED NOTHING UNUS

COMPLETED BY: J. Boylan DATE: 8/13/98

CHECKED BY: DATE:

573 521

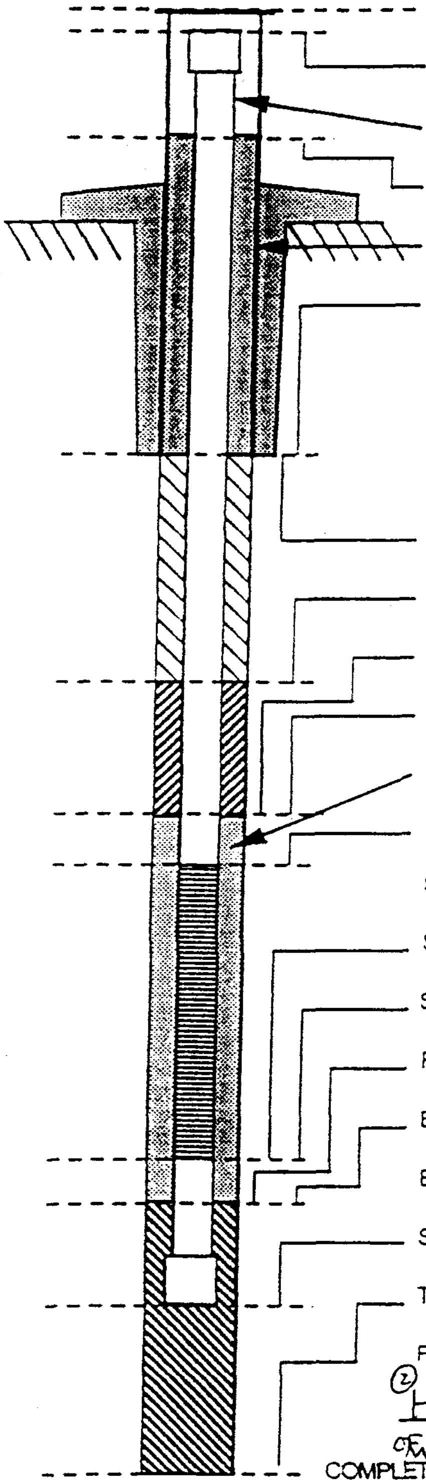
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3)
ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10498 PROJECT NAME: BLDG. 123 PROGRAM: GROUNDWATER
SCREENED FORMATION: ALLUVIUM DRILLING CONTRACTOR: TIERRA
DRILLING METHOD: GEOPROBE DATE DRILLED: 8/7/98 DATE COMPLETED: 8/13/98
RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: ——
COMPLETED DEPTH (FT): 12.1 ESTIMATED DEPTH TO BEDROCK (FT): NOT PENETRATED
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A
INITIAL WATER LEVEL (FT): 5.57 DATE MEASURED: 8/7/98
COMPLETED WATER LEVEL (FT): 5.42 DATE MEASURED: 8/12/98



PROTECTIVE CASING, TOP (FT): 0.0 (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.5 below ground FLUSH MOUNT
SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC
SURFACE SEAL, TOP (FT): -0.7 TYPE: CONCRETE
PROTECTIVE CASING, I.D. (IN): 8 TYPE: STEEL MANHOLE SKIRT
PROTECTIVE CASING, BOTTOM (FT): 1.0

IF APPLICABLE
SECONDARY CASING, TOP (FT): 0.35 BOTTOM (FT): 1.46
SECONDARY CASING, I.D. (IN): 2.0 TYPE: Sch 40 PVC

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): N/A TYPE:
BENTONITE SEAL, TOP (FT): ~~0.65~~ 0.8 (SW) TYPE: GRANULAR BENTONITE
BENTONITE SEAL, BOTTOM (FT): 2.0
FILTER PACK, TOP (FT): 2.0
FILTER PACK TYPE: 16/40 SILICA SAND PLUS CAVED "FLOWING" SANDS - SEE NOTE ② BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 6.12 SCREEN, TOP (FT): 6.12
SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): 11.93 TYPE: SCH 40 PVC BRAND:
SUMP, TOP (FT): 11.93 TYPE: THREADED END-CAP (NOT TRUE SUMP)
FILTER PACK, BOTTOM (FT): 12.1 (SEE NOTE ②)
BACKFILL, TOP (FT): N/A (SEE NOTE ②) TYPE: NATIVE MATERIALS
BACKFILL, BOTTOM (FT): N/A
SUMP, BOTTOM (FT): 12.08 ≈ 12.1
TOTAL DEPTH (FT): 12.1

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: ① SECONDARY CASING INSTALLED TO ENABLE USE OF 2" LOCKING J-PLUG
② HOLE COLLAPSED DURING ADDITION OF FILTER PACK: ADDED ENOUGH FOR ~3-4' OF ANNULUS, YET DEPTH SUDDENLY UP TO 2.0': EXPECT MIXED FILTER PACK & NATIVE MATERIALS, WHICH LOOK LIKE FILL (MODERATELY CLEAN SANDS).

COMPLETED BY: J. BOYLAN DATE: 8/7/98

CHECKED BY: DATE:

SST 528

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 10598 PROJECT NAME: BLDG. 123 PROGRAM: GROUNDWATER

SCREENED FORMATION: ALLUVIUM DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: GEOPROBE DATE DRILLED: 8/6/98 DATE COMPLETED: 8/13/98

RIG GEOLOGIST: J. BOYLAN LOGGING GEOLOGIST: —

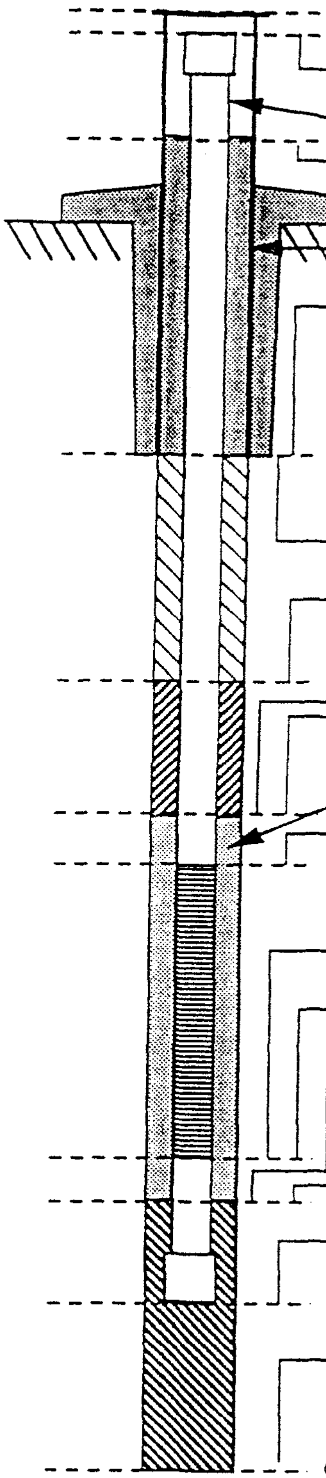
COMPLETED DEPTH (FT): 8.22 ESTIMATED DEPTH TO BEDROCK (FT): NOT PENETRATED

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): N/A

INITIAL WATER LEVEL (FT): 4.60 DATE MEASURED: 8/7/98

COMPLETED WATER LEVEL (FT): 4.67 DATE MEASURED: 8/11/98



PROTECTIVE CASING, TOP (FT): 0.0 (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.6 below ground FLUSH MOUNT

SURFACE CASING, I.D. (IN): 0.75 TYPE: Sch. 40 PVC

SURFACE SEAL, TOP (FT): ~0.7 TYPE: CONCRETE

PROTECTIVE CASING, I.D. (IN): 8 TYPE: STEEL MANHOLE SKIRT

PROTECTIVE CASING, BOTTOM (FT): 1.0

IF APPLICABLE SECONDARY CASING, TOP (FT): 0.4 BOTTOM (FT):

SECONDARY CASING, I.D. (IN): 2.0 TYPE: Sch 40 PVC

CENTRALIZER, O.D. (IN): N/A TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): N/A TYPE:

BENTONITE SEAL, TOP (FT): 0.8 TYPE: GRANULAR BENTONITE

BENTONITE SEAL, BOTTOM (FT): 1.7

FILTER PACK, TOP (FT): 1.7

FILTER PACK TYPE: 16/40 SILICA SAND BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 2.26 SCREEN, TOP (FT): 2.26

SCREEN SLOT SIZE (.000 IN): 0.010 SCREEN, I.D. (IN): 0.75

SCREEN, BOTTOM (FT): 8.07 TYPE: SCH 40 PVC BRAND:

SUMP, TOP (FT): 8.07 TYPE: THREADED END-CAP (NOT TRUE SUMP)

FILTER PACK, BOTTOM (FT): 8.22

BACKFILL, TOP (FT): 8.22 TYPE: NATIVE MATERIALS

BACKFILL, BOTTOM (FT): APPROX. 9.5

SUMP, BOTTOM (FT): 8.22

TOTAL DEPTH (FT): APPROX. 9.5 (1" HOLE BELOW 8.22')

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: ① SECONDARY CASING INSTALLED TO ENABLE USE OF 2" LOCKING J-CAP.
② HOLE COLLAPSED BELOW 8.22'.

COMPLETED BY: J. BOYLAN DATE: 8/6/98

CHECKED BY: DATE:

SDF 523

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
Rev.3 SRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20098 PROJECT NAME: North PA Plume PROGRAM: Groundwater

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra

DRILLING METHOD: Geoprobe / Push / Hammer DATE DRILLED: 6/23-24/98 DATE COMPLETED: 6/25/98

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: F. GRIGSBY

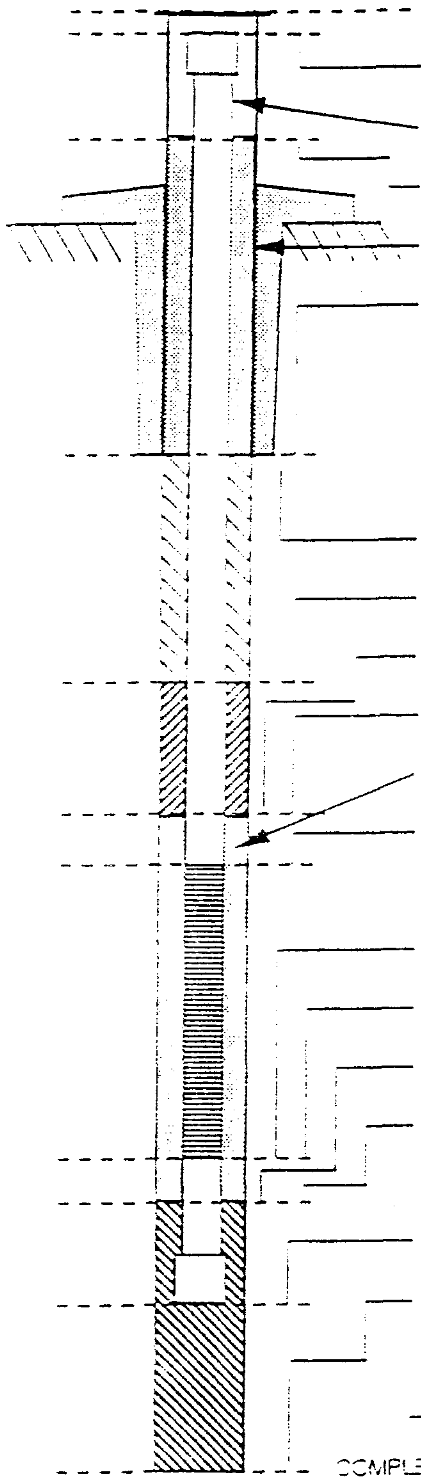
COMPLETED DEPTH (FT): 22.26 ft subsurf. ESTIMATED DEPTH TO BEDROCK (FT): ~~Between 18.0 and 19.4 ft subsurf.~~ FG FG.

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inches

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL.): NA

INITIAL WATER LEVEL (FT): 7.1 ft subsurf DATE MEASURED: 6-25-98

COMPLETED WATER LEVEL (FT): 7.71 ft subsurf DATE MEASURED: 7-1-98



PROTECTIVE CASING, TOP (FT): 0.0 (FROM GROUND SURFACE) FLUSH MOUNT SS = Subsurface

SURFACE CASING (STICKUP), TOP (FT): 0.55 ft ss

SURFACE CASING, I.D. (IN): 3/4 inch TYPE: Sch40 PVC

SURFACE SEAL, TOP (FT): 0.3 ft ss TYPE: Aquaseal Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 8 inch TYPE: Cast Iron Flush Mount

PROTECTIVE CASING, BOTTOM (FT): 1.08 ft ss

IF APPLICABLE SECONDARY CASING, TOP (FT): 0.37 ft ss BOTTOM (FT): 2.37 ft ss

SECONDARY CASING, I.D. (IN): 2 inch TYPE: Sch 40 PVC

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.3 ft ss TYPE: Aquaseal Granular Bentonite

BENTONITE SEAL, BOTTOM (FT): 10.0 ft ss

FILTER PACK, TOP (FT): 10.0 ft ss

FILTER PACK TYPE: 16-40 silica sand BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 12.33 ft ss SCREEN, TOP (FT): 12.33 ft ss

SCREEN SLOT SIZE (.000 IN): 0.010 inch SCREEN, I.D. (IN): 3/4 inch

SCREEN, BOTTOM (FT): 21.96 ft ss TYPE: Sch40 PVC BRAND: NA

SUMP, TOP (FT): 21.96 TYPE: Sch 40 PVC w/ pop rivet

FILTER PACK, BOTTOM (FT): 22.26 ft ss

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 22.26

TOTAL DEPTH (FT): 22.26

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Robert Koehler Robert Koehler DATE: 7/2/98

CHECKED BY: F. Grigsby DATE: 2-25-99

SW524

U.S. Department of Energy Rocky Flats Plant

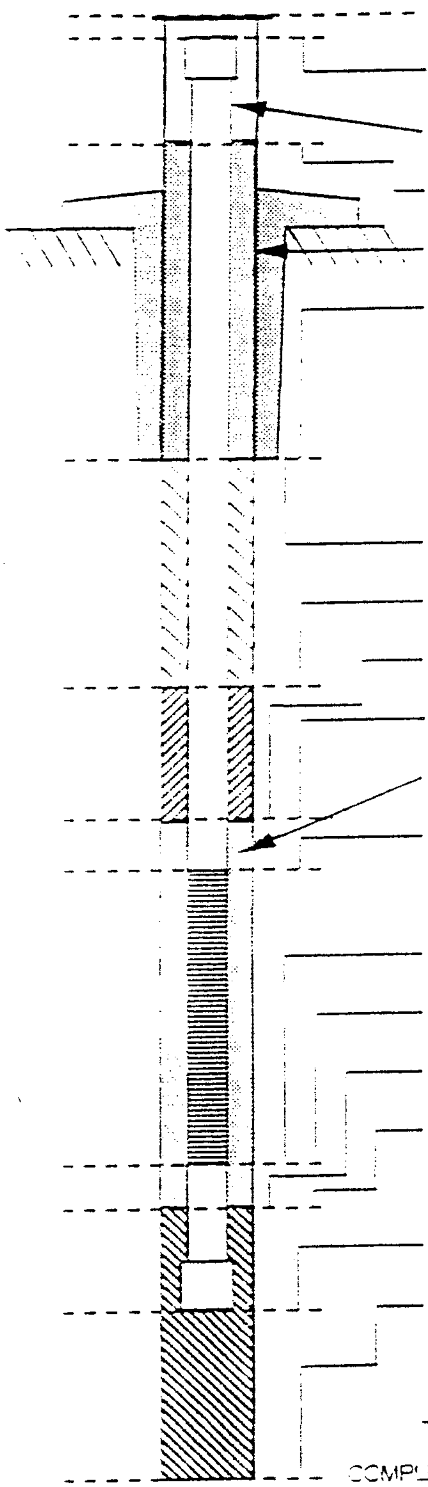
Form GT.6B (Rev.3) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20198
PROJECT NAME: North PA Plume
PROGRAM: Groundwater
SCREENED FORMATION: Alluvium
DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe/ Push/ Hammer
DATE DRILLED: 6/29/98
DATE COMPLETED: 7/1/98
RIG GEOLOGIST: R. Koehler
LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 9.96 ft subsurf.
ESTIMATED DEPTH TO BEDROCK (FT): 9.5 ~~to 16.0 ft~~ FG
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inch

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): NA
DATE MEASURED:
COMPLETED WATER LEVEL (FT): 7.51 ft ss
DATE MEASURED: 7/2/98
PROTECTIVE CASING, TOP (FT): 0.0 ft FROM GROUND SURFACE:

Flush, mount | SS = subsurface



SURFACE CASING (STICKUP), TOP (FT): 0.63 ft ss
SURFACE CASING, I.D. (IN): 3/4 inch TYPE: PVC Sch 40
SURFACE SEAL, TOP (FT): 0.3 ft ss TYPE: Aquaset Granular Bentonite
PROTECTIVE CASING, I.D. (IN): ~~2 inch~~ 8 inch RPK 7/2/98 TYPE: ~~PVC Sch 40~~ RPK 7/2/98 Cast Iron Flush Mount
PROTECTIVE CASING, BOTTOM (FT): 1.08 ft ss

IF APPLICABLE
SECONDARY CASING, TOP (FT): 0.33 ft ss BOTTOM (FT): 2.33 ft ss
SECONDARY CASING, I.D. (IN): 2 inch TYPE: PVC Sch 40

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL TOP (FT): NA TYPE:
BENTONITE SEAL TOP (FT): 0.8 ft ss TYPE: Aquaset Granular Bentonite
BENTONITE SEAL BOTTOM (FT): 4.0 ft ss
FILTER PACK, TOP (FT): 4.0 ft ss
FILTER PACK TYPE: 16-40 Silica Sand BRAND: Colorado Silica Sand Inc.
SURFACE CASING, BOTTOM (FT): 4.93 ft ss SCREEN, TOP (FT): 4.08 ft ss
SCREEN SLOT SIZE (.000 IN): 0.010 inch SCREEN, I.D. (IN): 3/4 inch
SCREEN, BOTTOM (FT): 9.77 ft ss TYPE: Sch 40 PVC BRAND: NA
SUMP, TOP (FT): 9.77 ft ss TYPE: Sch 40 PVC w/pop rivets
FILTER PACK, BOTTOM (FT): 10.0 ft ss
BACKFILL, TOP (FT): 10.0 ft ss TYPE: Aquaset Granular Bentonite
BACKFILL, BOTTOM (FT): 16.0 ft ss
SUMP, BOTTOM (FT): 9.96 ft ss
TOTAL DEPTH (FT): 16.0 ft ss

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: R. Koehler [signature] DATE: 7/2/98
CHECKED BY: F. Grigsby [signature] DATE: 02/25/99

SDT 525

U.S. Department of Energy Rocky Flats Plant

Form GT.6B (Rev.3) SRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20298 PROJECT NAME: North PA Plume PROGRAM: Groundwater

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: ~~Tierra~~ RPK 7/2/98

DRILLING METHOD: Geoprobe/Push/Hammer DATE DRILLED: 7-2-98 DATE COMPLETED: 7-2-98

RIG GEOLOGIST: R. Koehler LOGGING GEOLOGIST: F. Grigsby

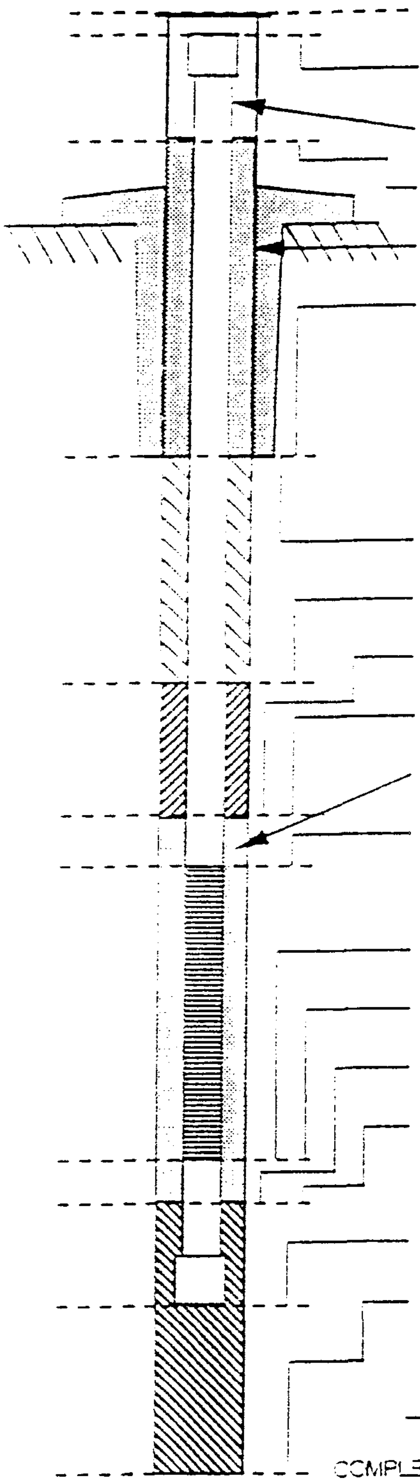
COMPLETED DEPTH (FT): 11.54 ft ss ESTIMATED DEPTH TO BEDROCK (FT): ~11.4 ft ss

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inch

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 7/2/98

COMPLETED WATER LEVEL (FT): NA DATE MEASURED: NA



PROTECTIVE CASING, TOP (FT): 0.0 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.42 ft ss

Flush Mount	SS = Subsurface

SURFACE CASING, I.D. (IN): 3/4 inch TYPE: PVC Sch 40

SURFACE SEAL, TOP (FT): 0.8 ft TYPE: Aquaset Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 8 inch TYPE: Cast Iron Flush mount

PROTECTIVE CASING, BOTTOM (FT): 1.08 ft ss

IF APPLICABLE

SECONDARY CASING, TOP (FT): 0.21 ft ss BOTTOM (FT): 2.21 ft ss

SECONDARY CASING, I.D. (IN): 2 inch TYPE: Sch 40 PVC

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.8 ft ss TYPE: Aquaset Granular Bentonite

BENTONITE SEAL, BOTTOM (FT): 4.6 ft ss

FILTER PACK, TOP (FT): 4.6 ft ss

FILTER PACK TYPE: 16-40 silica sand BRAND: C.S.S.I.

SURFACE CASING, BOTTOM (FT): 6.57 ft ss SCREEN, TOP (FT): 6.57 ft ss

SCREEN SLOT SIZE (.000 IN): 0.010 inch SCREEN, I.D. (IN): 3/4 inch

SCREEN, BOTTOM (FT): 11.19 ft ss TYPE: PVC sch 40 BRAND: NA

SUMP, TOP (FT): 11.19 ft ss TYPE: PVC Sch 40 w/ pop rivets

FILTER PACK, BOTTOM (FT): 11.6 ft ss

BACKFILL, TOP (FT): 11.6 ft ss TYPE: Aquaset Granular Bentonite

BACKFILL, BOTTOM (FT): 13.3 ~~11.6~~ ft ss

SUMP, BOTTOM (FT): 11.54 ft ss

TOTAL DEPTH (FT): 13.3 ft ss

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: R. Koehler [signature] DATE: 7/2/98

CHECKED BY: F. Grigsby [signature] DATE: 02/25/99

528 526

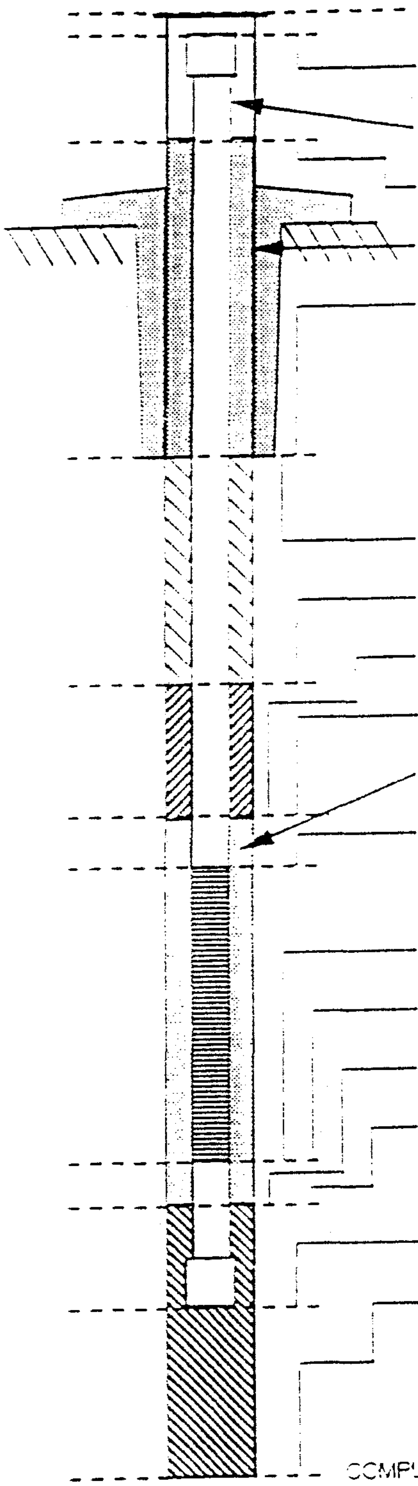
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev. 3) ~~2~~ RR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20398 PROJECT NAME: North PA Plume PROGRAM: Groundwater
SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe / Push / Hammer DATE DRILLED: 7/6/98 DATE COMPLETED: 7/7/98
RIG GEOLOGIST: R. Koehler LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 23 ESTIMATED DEPTH TO BEDROCK (FT): ~~19.5~~ 19.6 JRS
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inch

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): 10.7 ft. DATE MEASURED: 7/7/98
COMPLETED WATER LEVEL (FT): 10.22 ft DATE MEASURED: 7/8/98
(from top well casing)
PROTECTIVE CASING, TOP (FT): 0.0 FROM GROUND SURFACE



SURFACE CASING (STICKUP), TOP (FT): 0.5 ft SS

Flush Mount	S.S. = Subsurface

SURFACE CASING, I.D. (IN): 3/4 inch TYPE: PVC Sch40
SURFACE SEAL, TOP (FT): 0.7 ft SS TYPE: Aquaset Granular Bentonite
PROTECTIVE CASING, I.D. (IN): 0.82 ft TYPE: Cast iron flush mount
PROTECTIVE CASING, BOTTOM (FT): 1.08 ft SS

IF APPLICABLE
SECONDARY CASING, TOP (FT): 0.3 ft. BOTTOM (FT): 23 ft
SECONDARY CASING, I.D. (IN): 2 ~~inch~~ inch RPK 7/7 TYPE: Sch40 PVC

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 0.5 ft SS TYPE: Aquaset Granular Bentonite
BENTONITE SEAL, BOTTOM (FT): 3.5 ft SS
FILTER PACK, TOP (FT): 3.5 ft SS
FILTER PACK TYPE: 16-40 silica sand BRAND: Colorado Silica Sand Inc
SURFACE CASING, BOTTOM (FT): 10.37 ft SCREEN, TOP (FT): 10.37 ft
SCREEN SLOT SIZE (.000 IN): 0.010 inch SCREEN, I.D. (IN): 3/4 inch
SCREEN, BOTTOM (FT): 22.89 ft TYPE: PVC Sch40 BRAND: NA
SUMP, TOP (FT): 22.89 ft SS TYPE: Pipe rivet Sch40 PVC
FILTER PACK, BOTTOM (FT): 23.19 ft SS
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 23.19 ft SS
TOTAL DEPTH (FT): 23.19 ft SS

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Robert Koehler DATE: 7-8-98
CHECKED BY: F. Grigsby Fred Grigsby DATE: 02/25/99

~~588~~ 527

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3)
ERR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20498 PROJECT NAME: North PA Plume PROGRAM: Groundwater

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra

DRILLING METHOD: Geoprobe / Push / Hammer DATE DRILLED: 7-7-98 DATE COMPLETED: 7-9-98

RIG GEOLOGIST: R. Koehler LOGGING GEOLOGIST: R. Koehler / F. Grigsby

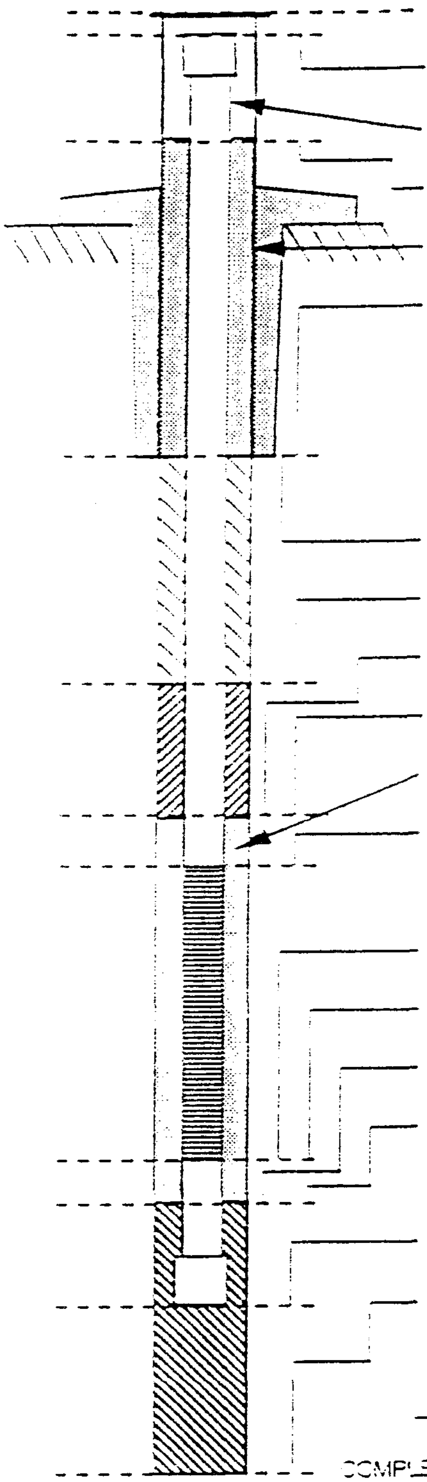
COMPLETED DEPTH (FT): 22.25 ft ss ESTIMATED DEPTH TO BEDROCK (FT): 21.0 ~~22.0 ft~~

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inch

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL.): NA

INITIAL WATER LEVEL (FT): 11.31 ft ss DATE MEASURED: 7/9/98

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.0 ft FROM GROUND SURFACE:

Flush Mount | ss = subsurface

SURFACE CASING (STICKUP), TOP (FT): 0.53 ft ss

SURFACE CASING, I.D. (IN): 3/4 inch TYPE: PVC Sch. 40

SURFACE SEAL, TOP (FT): 0.7 ft ss TYPE: Aquaset Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 0.32 ft TYPE: Cast Iron flush mount

PROTECTIVE CASING, BOTTOM (FT): 1.08 ft ss.

IF APPLICABLE

SECONDARY CASING, TOP (FT): 0.25 ft ss BOTTOM (FT): 2.25 ft ss

SECONDARY CASING, I.D. (IN): 2 inch TYPE: PVC Sch 40

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 0.7 ft ss TYPE: Aquaset Granular Bentonite

BENTONITE SEAL, BOTTOM (FT): 10.5 ft ss

FILTER PACK, TOP (FT): 10.5 ft ss

FILTER PACK TYPE: 16-40 Silica Sand BRAND: Colorado Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 12.35 ft ss SCREEN, TOP (FT): 12.35 ft ss

SCREEN SLOT SIZE (.000 IN): 0.010 inch SCREEN, I.D. (IN): 3/4 inch

SCREEN, BOTTOM (FT): 21.98 ft ss TYPE: PVC Sch 40 BRAND: NA

SUMP, TOP (FT): 21.98 ft ss TYPE: PVC Sch 40 w/ pop rivets

FILTER PACK, BOTTOM (FT): 22.25 ft ss

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 22.25 ft ss

TOTAL DEPTH (FT): 22.25 ft ss

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Robert Koehler DATE: 7/9/98

CHECKED BY: Fred Grigsby DATE: 2/26/99

510 528

U.S. Department of Energy Rocky Flats Plant

Form GT.3B
Rev.3

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20598 PROJECT NAME: PA North Plume PROGRAM:

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra

DRILLING METHOD: Geoprobe, Continuous Core DATE DRILLED: 07-13-98 DATE COMPLETED: 07-13-98

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

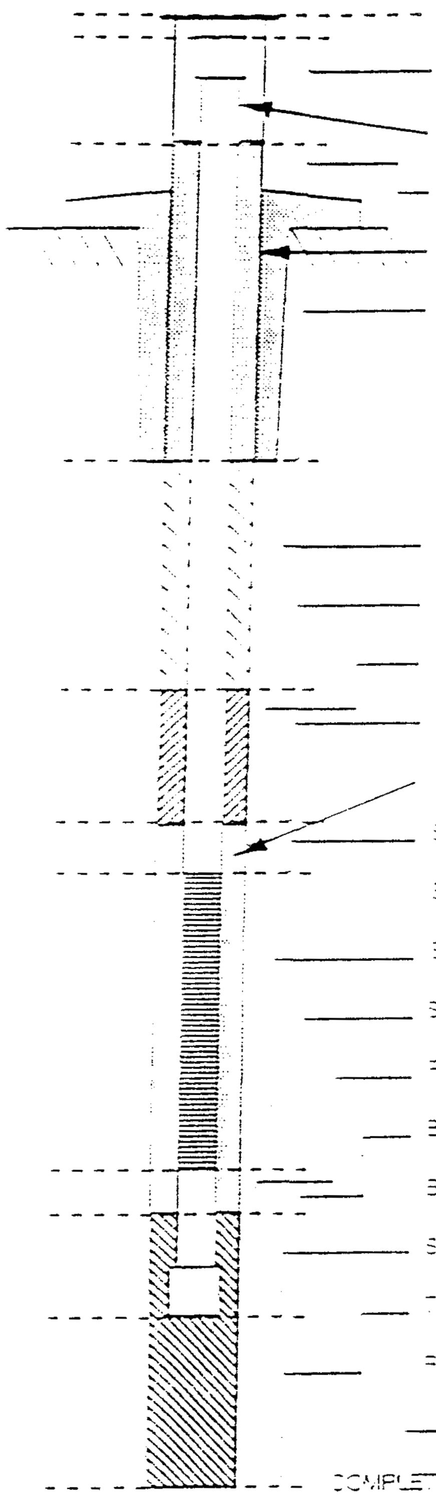
COMPLETED DEPTH (FT): ~~21.0~~ 15.5 ESTIMATED DEPTH TO BEDROCK (FT): 14.5'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): None DATE MEASURED: 07-13-98

COMPLETED WATER LEVEL (FT): — DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.0' FROM GROUND SURFACE: (Flush Mount)

SURFACE CASING STICKUP, TOP (FT): -0.7 BGS

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC Sch. 40

SURFACE SEAL, TOP (FT): 0.9 TYPE: Aquaset Granular Benton.

PROTECTIVE CASING, I.D. (IN): 0.82 ft TYPE: Flush Mount

PROTECTIVE CASING, BOTTOM (FT): 1.1'

IF APPLICABLE: SECONDARY CASING, TOP (FT): 0.25' BOTTOM (FT): 2.25

SECONDARY CASING, I.D. (IN): 2 in TYPE: PVC Sch 40

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 1.1' TYPE: Granular Bentonite

BENTONITE SEAL, BOTTOM (FT): 4.7

FILTER PACK, TOP (FT): 4.7'

FILTER PACK TYPE: 16-40 Silica Sd. BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 5.7' SCREEN, TOP (FT): 5.7'

SCREEN SLOT SIZE (.000 IN): 010 in SCREEN I.D. (IN): 3/4 in

SCREEN, BOTTOM (FT): 15.2 TYPE: PVC Sch 40 BRAND: CEE

SUMP, TOP (FT): 15.2' TYPE: Riveted PVC

FILTER PACK, BOTTOM (FT): 15.2

BACKFILL, TOP (FT): 15.2 TYPE: Granular Bentonite

BACKFILL, BOTTOM (FT): 21.0'

SUMP, BOTTOM (FT): 15.5'

TOTAL DEPTH (FT): 21.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred Grigsby DATE: 07-14-98

CHECKED BY: DATE:

531 529

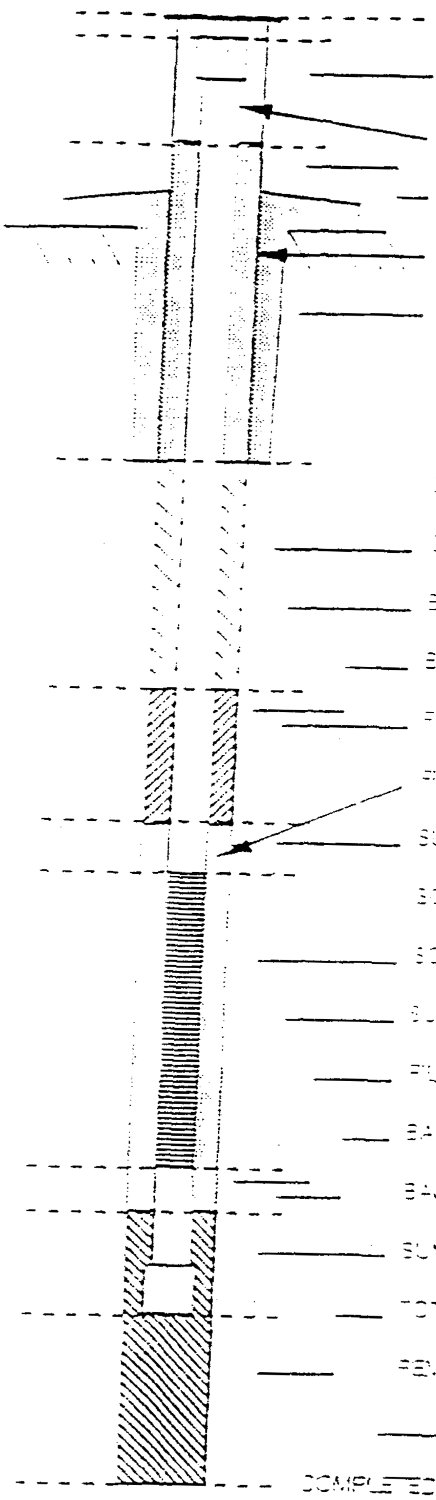
U.S. Department of Energy Rocky Flats Plant

Form GT.38
Rev. 01

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20698
PROJECT NAME: PA N. Plume
PROGRAM:
SCREENED FORMATION: Alluvium
DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe - Continuous Core
DATE DRILLED: 07-14-98
DATE COMPLETED:
RIG GEOLOGIST: F. Grigsby
LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): ~~24.0~~ 21.9
ESTIMATED DEPTH TO BEDROCK (FT): 20.4'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): None
DATE MEASURED: 07-14-98
COMPLETED WATER LEVEL (FT):
DATE MEASURED:



- PROTECTIVE CASING, TOP (FT): 0.0' FROM GROUND SURFACE (Flush Mount)
- SURFACE CASING STICKUP, TOP (FT): 0.3' (BGS)
- SURFACE CASING, I.D. (IN): 3/4 in. TYPE: PVC Sch. 40
- SURFACE SEAL, TOP (FT): 0.7 TYPE: Aquaset Granular Bentonite
- PROTECTIVE CASING, O.D.: 0.82 ft. TYPE: Flush Mount
- PROTECTIVE CASING, BOTTOM (FT): 1.1'
- IF APPLICABLE: SECONDARY CASING, TOP (FT): 0.25' BOTTOM (FT): 2.0'
- SECONDARY CASING, I.D. (IN): 2.0 in. TYPE: PVC Sch. 40
- CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
- GROUT SEAL, TOP (FT): NA TYPE:
- BENTONITE SEAL, TOP (FT): ~~1.9~~ 1.1 TYPE: Granular Bentonite
- BENTONITE SEAL, BOTTOM (FT): 9.9'
- FILTER PACK, TOP (FT): 9.9'
- FILTER PACK TYPE: 16-40 Silica Sd. BRAND: CSSI
- SURFACE CASING, BOTTOM (FT): 12.0' SCREEN, TOP (FT): 12.0'
- SCREEN SLOT SIZE (IN): .010 in SCREEN I.D. (IN): 3/4"
- SCREEN, BOTTOM (FT): 21.6 TYPE: PVC Sch 40 BRAND: GEI
- SUMP, TOP (FT): 21.6 TYPE: PVC Cap/Rivet
- FILTER PACK, BOTTOM (FT): 21.9
- BACKFILL, TOP (FT): 21.9 TYPE: Natural Materials
- BACKFILL, BOTTOM (FT): 24.0'
- SUMP, BOTTOM (FT): 21.9'
- TOTAL DEPTH (FT): 24.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 07-14-98

CHECKED BY: DATE:

SF 530

U.S. Department of Energy Rocky Flats Plant

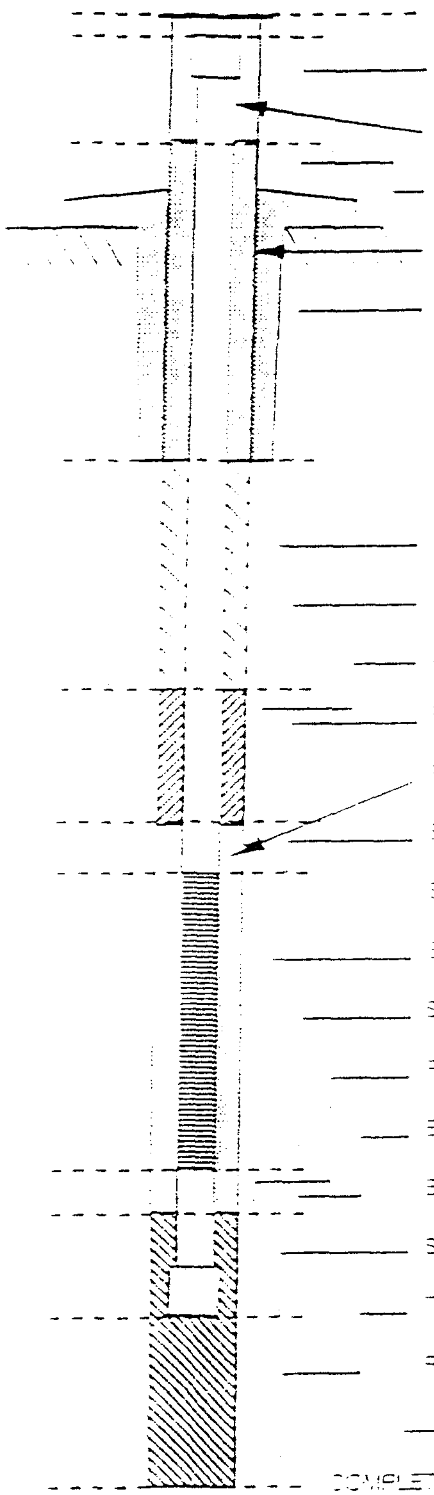
Form GT.6B
Rev.01

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20798 PROJECT NAME: North PA Plume PROGRAM:
SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Terra
DRILLING METHOD: Geoprobe - Continuous Core DATE DRILLED: 07-16-98 DATE COMPLETED: 07-16-98
RIG GEOLOGIST: J. Boylan / F. Grigsby LOGGING GEOLOGIST: F. Grigsby / J. Boylan
COMPLETED DEPTH (FT): ~~27.0~~ 27.2 ESTIMATED DEPTH TO BEDROCK (FT): 26.2'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): 15.71 DATE MEASURED: 07-16-98
COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.0' FROM GROUND SURFACE: (Flush Mount)
SURFACE CASING (STICKUP) TOP (FT): -0.6 (BGS)
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC Sch. 40
SURFACE SEAL TOP (FT): -0.9' TYPE: Aquaset Granular Bentonite
PROTECTIVE CASING, I.D.: 0.82 ft. TYPE: Flush Mount
PROTECTIVE CASING, BOTTOM (FT): 1.1'
IF APPLICABLE: SECONDARY CASING, TOP (FT): 0.25 (BGS) BOTTOM (FT): 2.25
SECONDARY CASING, I.D. (IN): 2 in TYPE: PVC Sch. 40
CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL TOP (FT): NA TYPE:
BENTONITE SEAL TOP (FT): 1.1 TYPE: Granular Bentonite
BENTONITE SEAL BOTTOM (FT): 14.4'
FILTER PACK, TOP (FT): 14.4'
FILTER PACK TYPE: 16-40 Silica Sd. BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 15.4' SCREEN TOP (FT): 15.4'
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN I.D. (IN): 3/4 in.
SCREEN BOTTOM (FT): 26.9 TYPE: PVC Sch 40 BRAND: CEI
SUMP TOP (FT): 26.9 TYPE: PVC Cap - Rivetted
FILTER PACK, BOTTOM (FT): 27.2
BACKFILL TOP (FT): 27.2 TYPE: Granular Bentonite
BACKFILL BOTTOM (FT): 29.0'
SUMP BOTTOM (FT): 27.2
TOTAL DEPTH (FT): 29.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 03-01-99

CHECKED BY: DATE:

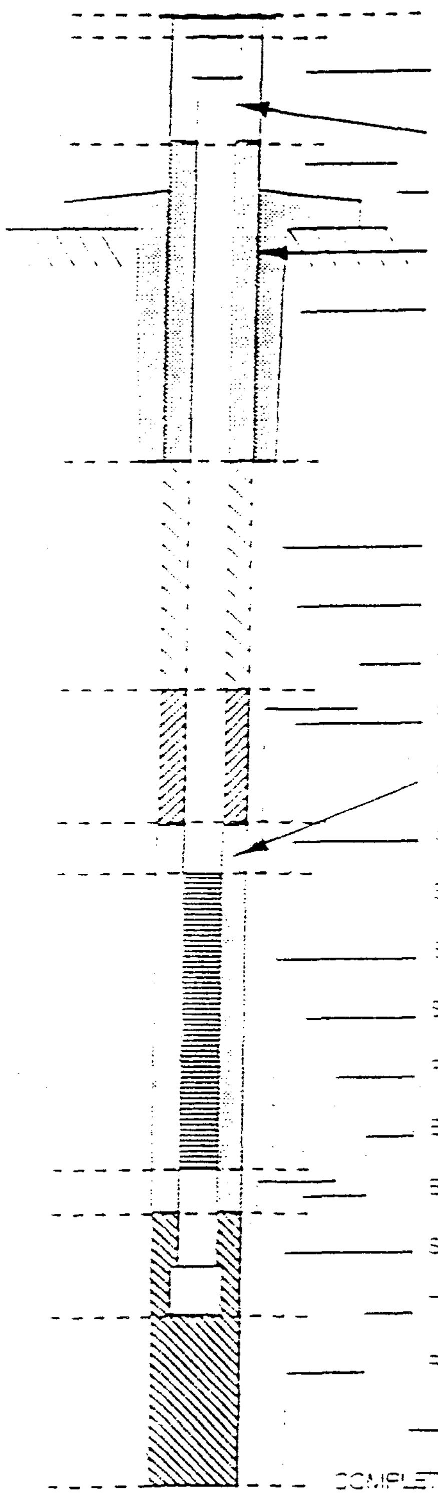
88531

U.S. Department of Energy Rocky Flats Plant

Form GT.38
Rev.3
[illegible]

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20898 PROJECT NAME: PA - North Plume PROGRAM:
SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe - Continuous Core DATE DRILLED: 07-17-98 DATE COMPLETED: 07-17-
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 16.1' ESTIMATED DEPTH TO BEDROCK (FT): 15.6'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in



QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): None DATE MEASURED: 07-17-98
COMPLETED WATER LEVEL (FT): DATE MEASURED:
PROTECTIVE CASING, TOP (FT): 0-0' FROM GROUND SURFACE (Flush Mount
SURFACE CASING STICKUP, TOP (FT): -0.5 (BGS)
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - sch. 40
SURFACE SEAL TOP (FT): -0.7 TYPE: Granular Bentonite
PROTECTIVE CASING, I.D. (IN): 0.82 ft TYPE: Flush Mount
PROTECTIVE CASING, BOTTOM (FT): 1.1'
IF APPLICABLE
SECONDARY CASING, TOP (FT): -0.3' (BGS) BOTTOM (FT): 2.3'
SECONDARY CASING, I.D. (IN): 2 in TYPE: PVC - sch 40
CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL TOP (FT): NA TYPE:
BENTONITE SEAL TOP (FT): 1.1' TYPE: Granular Bentonite
BENTONITE SEAL BOTTOM (FT): 7.0'
FILTER PACK, TOP (FT): 7.0'
FILTER PACK TYPE: 16-40 Silica sd BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 7.8' SCREEN, TOP (FT): 7.8'
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in
SCREEN, BOTTOM (FT): 15.8' TYPE: PVC sch. 40 BRAND: CEI
SUMP, TOP (FT): 15.8 TYPE: PVC Cap Rivotted
FILTER PACK, BOTTOM (FT): 16.1
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 16.1
TOTAL DEPTH (FT): 16.1

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 03-01-99

CHECKED BY: DATE:

SH 532

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
Rev. 3

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20998 PROJECT NAME: PA - N. Plume PROGRAM:

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra Environmental

DRILLING METHOD: Geoprobe - Continuous Core DATE DRILLED: 08-18-98 DATE COMPLETED: 08-18-98

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

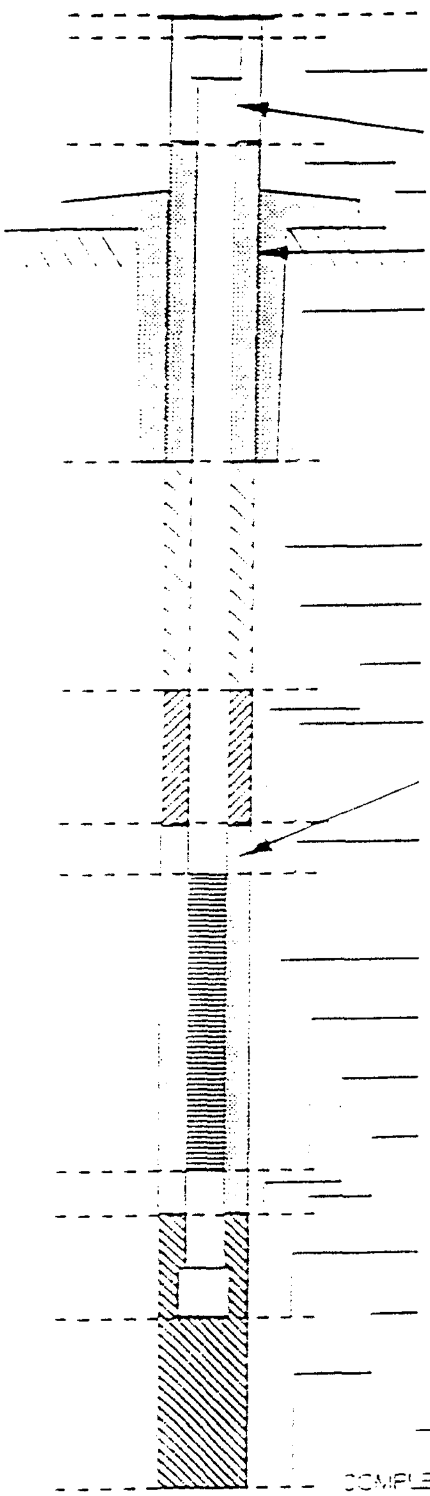
COMPLETED DEPTH (FT): 10.9' ESTIMATED DEPTH TO BEDROCK (FT): 10.3'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 08-18-98

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 1.2' FROM GROUND SURFACE:

SURFACE CASING STICKUP, TOP (FT): 0.9'

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC Sch. 40

SURFACE SEAL, TOP (FT): GL TYPE: Bentonite Granular

PROTECTIVE CASING, I.D. (IN): 2 in TYPE: PVC Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.8'

IF APPLICABLE: SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): GL TYPE: Granular Bentonite (Aquaset)

BENTONITE SEAL, BOTTOM (FT): 4.9'

FILTER PACK, TOP (FT): 4.9'

FILTER PACK TYPE: 16-40 Silica Sd. BRAND: C S S I

SURFACE CASING, BOTTOM (FT): 5.9' SCREEN, TOP (FT): 5.9'

SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.

SCREEN, BOTTOM (FT): 10.6' TYPE: PVC Sch 40 BRAND: CEI

SUMP, TOP (FT): 10.6' TYPE: PVC Cap - Riveted

FILTER PACK, BOTTOM (FT): 10.9'

BACKFILL, TOP (FT): NA TYPE:

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): 10.9'

TOTAL DEPTH (FT): 10.9'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Original Construction Form Done 08/18/98

Recopied 03-01-98

COMPLETED BY: Fred C. Grigsby DATE: 03-01-99

CHECKED BY: DATE:

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U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 20998 PROJECT NAME: N. PA. PLUME PROGRAM:

SCREENED FORMATION: Alluv. DRILLING CONTRACTOR: Tierra Environmental

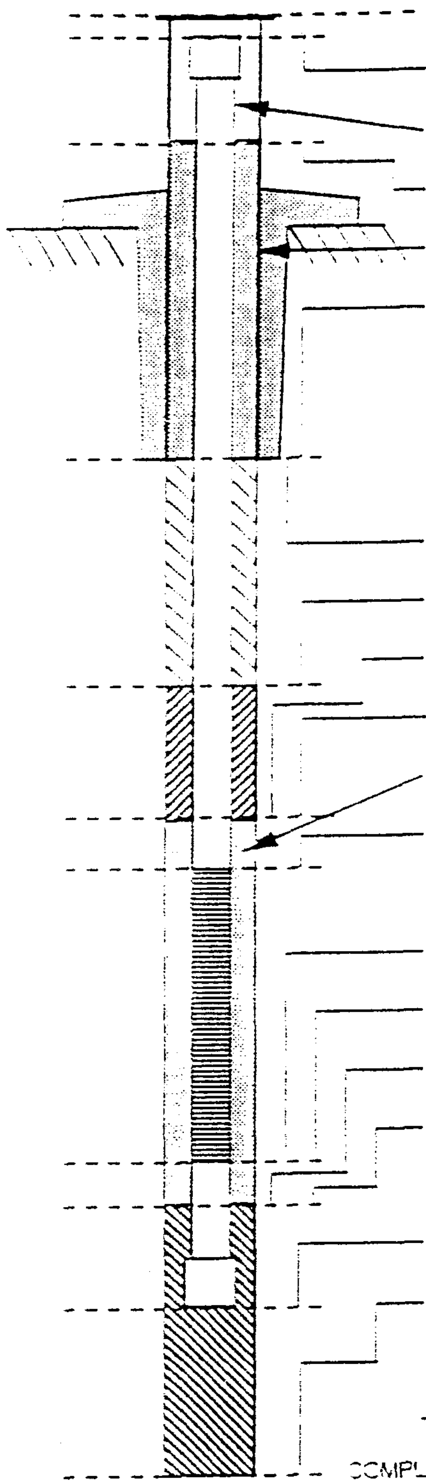
DRILLING METHOD: Geoprobe DATE DRILLED: 08-18-98 DATE COMPLETED: 08-18-98

RIG GEOLOGIST: E. Grigsby LOGGING GEOLOGIST: E. Grigsby

COMPLETED DEPTH (FT): 10.9' ESTIMATED DEPTH TO BEDROCK (FT): 10.3'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA



INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 08-17-98

COMPLETED WATER LEVEL (FT): DATE MEASURED:

PROTECTIVE CASING, TOP (FT): ~~[illegible]~~ T.I. 66 ok FROM GROUND SURFACE ~~Flush mount~~

SURFACE CASING (STICKUP), TOP (FT): 0.9' (ok)

SURFACE CASING, I.D. (IN): 3/4" TYPE PVC

SURFACE SEAL TOP (FT): GL. TYPE Bentonite granules

PROTECTIVE CASING, I.D. (IN): 2 TYPE PVC

PROTECTIVE CASING, BOTTOM (FT): 0.8'

IF APPLICABLE SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA. TYPE

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE NA

BENTONITE SEAL TOP (FT): GL TYPE (Aquaseal)

BENTONITE SEAL BOTTOM (FT): 4.9'

FILTER PACK, TOP (FT): 4.9'

FILTER PACK TYPE: Silica Sand BRAND: CSS 5

SURFACE CASING, BOTTOM (FT): 5.9' SCREEN, TOP (FT): 5.9'

SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 3/4

SCREEN, BOTTOM (FT): 10.96 JAB TYPE PVC BRAND:

SUMP TOP (FT): ~~NA~~ JAB 10.6 TYPE JAB ~~NA~~ PVC end cap (not true sump)

FILTER PACK, BOTTOM (FT): 10.9'

BACKFILL, TOP (FT): NA TYPE NA

BACKFILL, BOTTOM (FT): NA

SUMP, BOTTOM (FT): JAB ~~NA~~ 10.9

TOTAL DEPTH (FT): 10.9'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 08-18-98

CHECKED BY: DATE:

~~536~~ 534

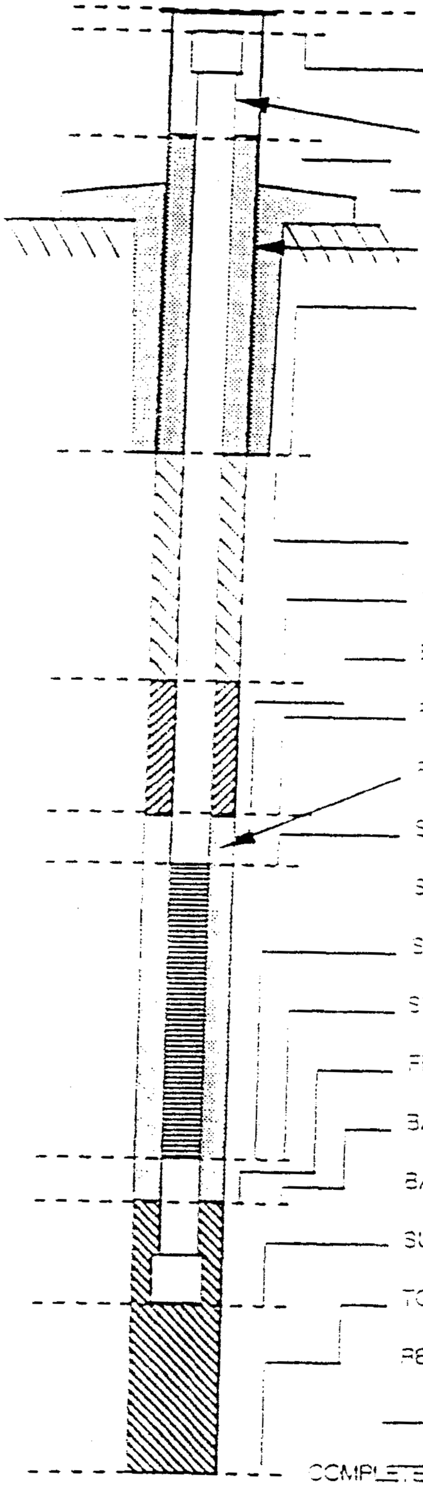
U.S. Department of Energy Rocky Flats Plant

Form GT.5B
Rev.01
SRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21098
PROJECT NAME: PA - North Plume
PROGRAM:
SCREENED FORMATION: Alluvium
DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe - Continuous Core
DATE DRILLED: 07-20-98
DATE COMPLETED: 07-20-98
RIG GEOLOGIST: F. Grigsby
LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): ~~20.0~~ 19.2
ESTIMATED DEPTH TO BEDROCK (FT): 18.2
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL.): NA
INITIAL WATER LEVEL (FT): None
DATE MEASURED: 07-20-98
COMPLETED WATER LEVEL (FT):
DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 1.0' ± (FROM GROUND SURFACE)
SURFACE CASING (STICKUP), TOP (FT): 0.5'
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC - Sch 40
SURFACE SEAL, TOP (FT): GL TYPE: Aquaset - Granular Bentonite
PROTECTIVE CASING, I.D. (IN): 2 in TYPE: PVC - Sch. 40
PROTECTIVE CASING, BOTTOM (FT): 1.0'

IF APPLICABLE
SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): GL TYPE:
BENTONITE SEAL, BOTTOM (FT): 8.3'
FILTER PACK, TOP (FT): 8.3'
FILTER PACK TYPE: 16-40 Silica Sd. BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 9.4' SCREEN, TOP (FT): 9.4'
SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 18.9' TYPE: PVC Sch 40 BRAND: CEI
SUMP, TOP (FT): 18.9 TYPE: PVC cap - Rivets
FILTER PACK, BOTTOM (FT): 20.0'
BACKFILL, TOP (FT): ~~?~~ 19.2 TYPE: Filter Pack
BACKFILL, BOTTOM (FT): 20.0'
SUMP, BOTTOM (FT): 19.2'
TOTAL DEPTH (FT): 20.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred C. Grigsby DATE: 03-01-99
CHECKED BY: DATE:

~~537~~ 535

U.S. Department of Energy Rocky Flats Plant

Form GT.6B
Rev. 3
SRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21198 PROJECT NAME: PA - North Plume PROGRAM:

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra

DRILLING METHOD: Geoprobe Continuous Core DATE DRILLED: 07-22-98 DATE COMPLETED: 07-22

RIG GEOLOGIST: J. Boylan / F. Grigsby LOGGING GEOLOGIST: J. Boylan / F. Grigsby

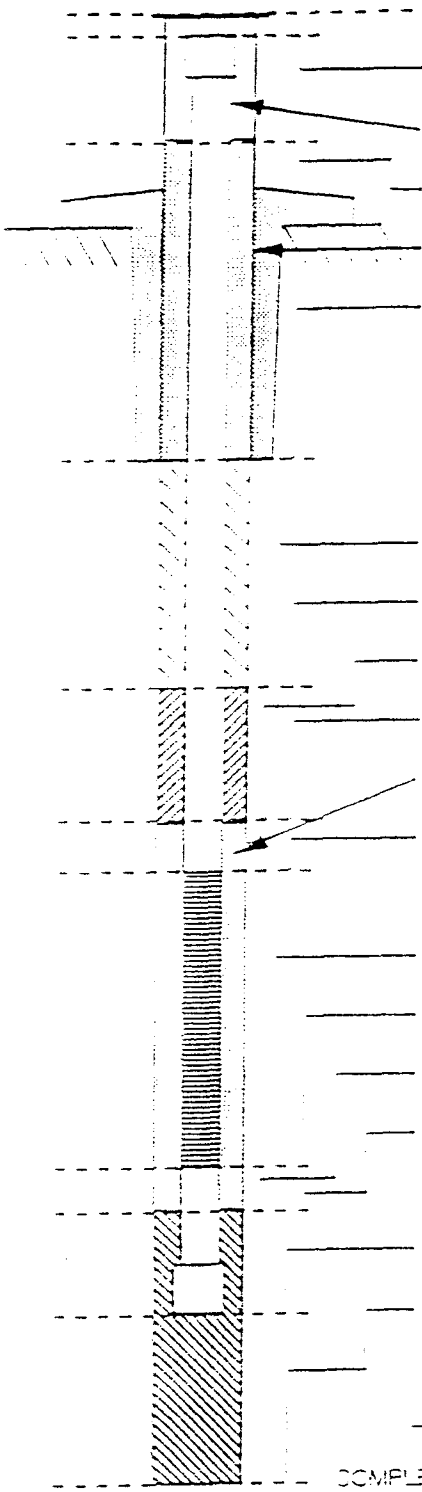
COMPLETED DEPTH FT: ~~29.5'~~ 29.4 ESTIMATED DEPTH TO BEDROCK FT: 28.0'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): 13.9' DATE MEASURED: 07-22-98

COMPLETED WATER LEVEL FT: DATE MEASURED:



PROTECTIVE CASING, TOP FT: 0.75 FROM GROUND SURFACE

SURFACE CASING STICKUP, TOP FT: 0.5'

SURFACE CASING, I.D. IN: 3/4 in TYPE: PVC Sch. 40

SURFACE SEAL, TOP FT: GL. TYPE: Granular Bentonite - Aquaseal

PROTECTIVE CASING, I.D. IN: 2" TYPE: PVC Sch. 40

PROTECTIVE CASING, BOTTOM FT: 1.25'

IF APPLICABLE: SECONDARY CASING, TOP FT: NA BOTTOM FT:

SECONDARY CASING, I.D. IN: NA TYPE:

CENTRALIZER, O.D. IN: NA TOP FT: BOTTOM FT:

GROUT SEAL TOP FT: NA TYPE:

BENTONITE SEAL TOP FT: GL TYPE: Granular Bentonite

BENTONITE SEAL BOTTOM FT: 8.0

FILTER PACK, TOP FT: 8.0'

FILTER PACK TYPE: 16-40 Silica Sd. BRAND: CSSI

SURFACE CASING, BOTTOM FT: 14.7 SCREEN, TOP FT: 14.7

SCREEN SLOT SIZE (.000 IN): 010 SCREEN I.D. IN: 3/4"

SCREEN, BOTTOM FT: 29.1 TYPE: PVC Sch 40 BRAND: CEI

SUMP TOP FT: 29.1' TYPE: PVC Cap - Rivetted

FILTER PACK, BOTTOM FT: 29.4'

BACKFILL, TOP FT: NA. TYPE:

BACKFILL, BOTTOM FT: NA

SUMP BOTTOM (FT): 29.4

TOTAL DEPTH FT: 29.5'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS: Filter Pack would not flow to bottom of hole - Most of screen in formation sd & gravel

COMPLETED BY: Fred C. Grigsby DATE: 03-01-99

CHECKED BY: DATE:

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U.S. Department of Energy Rocky Flats Plant

Form GT.6B
Rev. 01

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21298 PROJECT NAME: N- PA PLUME PROGRAM:

SCREENED FORMATION: Qal DRILLING CONTRACTOR: Tierra Environmental

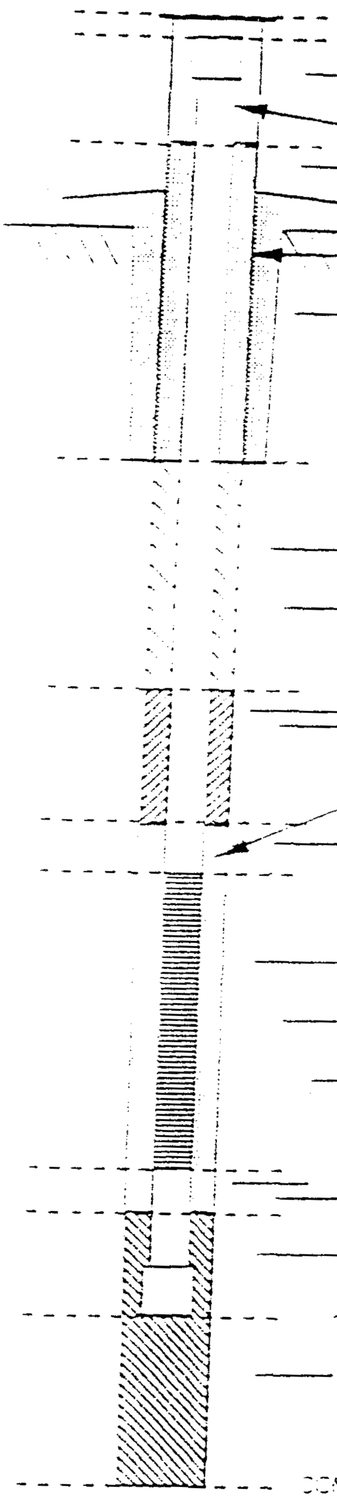
DRILLING METHOD: Geoprobe DATE DRILLED: 08-19-98 DATE COMPLETED: 08-19-98

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

COMPLETED DEPTH (FT): 20.0' ESTIMATED DEPTH TO BEDROCK (FT): 19.1

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA



INITIAL WATER LEVEL (FT): DATE MEASURED:

COMPLETED WATER LEVEL (FT): DATE MEASURED:

PROTECTIVE CASING, TOP (FT): ±0.1 FROM GROUND SURFACE: (Flush Mount)

SURFACE CASING STICKUP, TOP (FT): −0.3

SURFACE CASING, ID (IN): 0.75 TYPE: PVC

SURFACE SEAL, TOP (FT): GL TYPE: Cement (Quickcrete)

PROTECTIVE CASING, ID (IN): 8in TYPE: Flush Mount.

PROTECTIVE CASING, BOTTOM (FT): 1.0' (Bottom of Flush Mount)

IF APPLICABLE: SECONDARY CASING, TOP (FT): BOTTOM (FT):

SECONDARY CASING, ID (IN): 2in TYPE: PVC

CENTRALIZER, O.D. (IN): NA TOP (FT): NA BOTTOM (FT): NA

GROUT SEAL, TOP (FT): NA TYPE:

BENTONITE SEAL, TOP (FT): 1.0' TYPE: Bentonite Granules.

BENTONITE SEAL, BOTTOM (FT): 9.0'

FILTER PACK, TOP (FT): 9.0'

FILTER PACK TYPE: Silica Sd (10-40) BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 10.07' SCREEN, TOP (FT): 10.07

SCREEN SLOT SIZE (.001 IN): .010 SCREEN, ID (IN): 0.75

SCREEN, BOTTOM (FT): ~~20.0~~ 19.7 TYPE: PVC BRAND: CEL

SUMP, TOP (FT): ~~NA~~ 19.7 TYPE: Screw on Cap/Rivetedplug

FILTER PACK, BOTTOM (FT): 20.0'

BACKFILL, TOP (FT): 20.0' TYPE: Natural

BACKFILL, BOTTOM (FT): 21.0'

SUMP BOTTOM (FT): ~~NA~~ 20.0'

TOTAL DEPTH (FT): 21.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS: Hole deepened to 21.0' during Clean out run. - Original depth was 20.0'

COMPLETED BY: Fred Grigsby DATE: 08-20-98

CHECKED BY: DATE:

~~538~~ 537

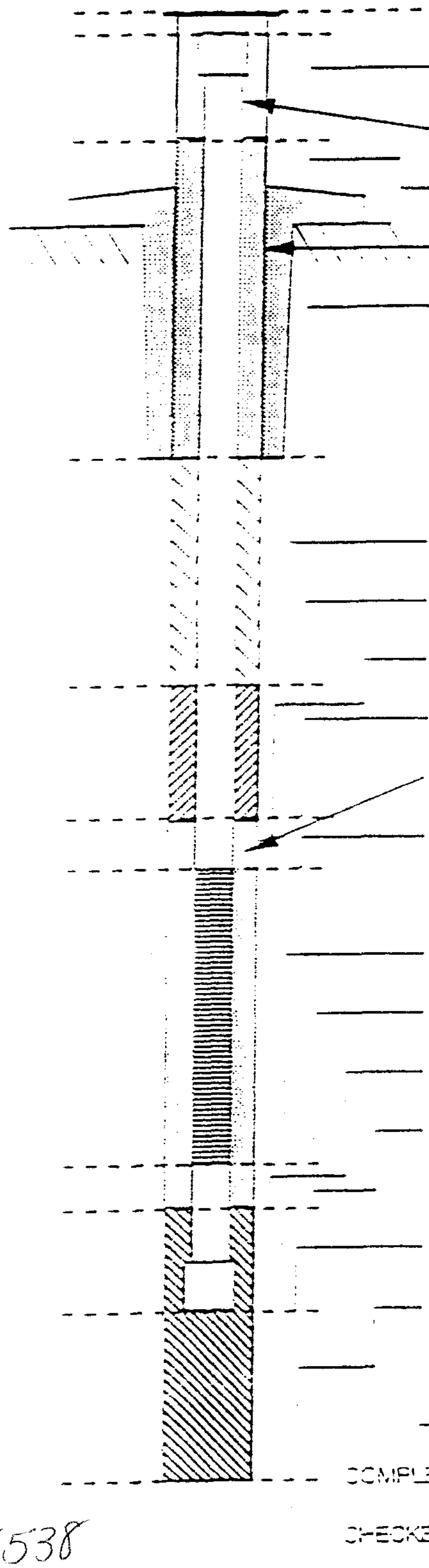
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
Rev.3
[illegible] 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21398 PROJECT NAME: N PA Plume PROGRAM:
SCREENED FORMATION: Qal DRILLING CONTRACTOR: Tierra Environmental
DRILLING METHOD: Geoprobe DATE DRILLED: 08-25-98 DATE COMPLETED: 08-25-98
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): ~~14.0~~ 14.0 ESTIMATED DEPTH TO BEDROCK (FT): 13.1'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 08-25-98
COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 1.0' (FROM GROUND SURFACE)
SURFACE CASING STICKUP, TOP (FT): 0.7'
SURFACE CASING, I.D. (IN): 0.75 TYPE: PVC
SURFACE SEAL, TOP (FT): GL TYPE: Bentonite Granules
PROTECTIVE CASING, I.D. (IN): 2 TYPE: PVC
PROTECTIVE CASING, BOTTOM (FT): 1.0'
IF APPLICABLE: SECONDARY CASING, TOP (FT): NA BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA TYPE:
CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): GL TYPE:
BENTONITE SEAL, BOTTOM (FT): 6.0'
FILTER PACK, TOP (FT): 6.0'
FILTER PACK TYPE: 16-40 Silica Sd. BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 7.1 SCREEN, TOP (FT): 7.1
SCREEN SLOT SIZE (.000 IN): .010 SCREEN, I.D. (IN): 0.75
SCREEN, BOTTOM (FT): ~~14.0~~ 13.7 FG TYPE: PVC-Sch. 40 BRAND: CEI
SUMP, TOP (FT): ~~NA~~ 13.7 FG TYPE: PVC Cap/Riveted
FILTER PACK, BOTTOM (FT): 14.0'
BACKFILL, TOP (FT): 14.0 TYPE: Bentonite Granules
BACKFILL, BOTTOM (FT): 16.0'
SUMP, BOTTOM (FT): ~~NA~~ 14.0' FG
TOTAL DEPTH (FT): 16.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred Grigsby DATE: 08-25-98
CHECKED BY: DATE:

~~540~~ 538

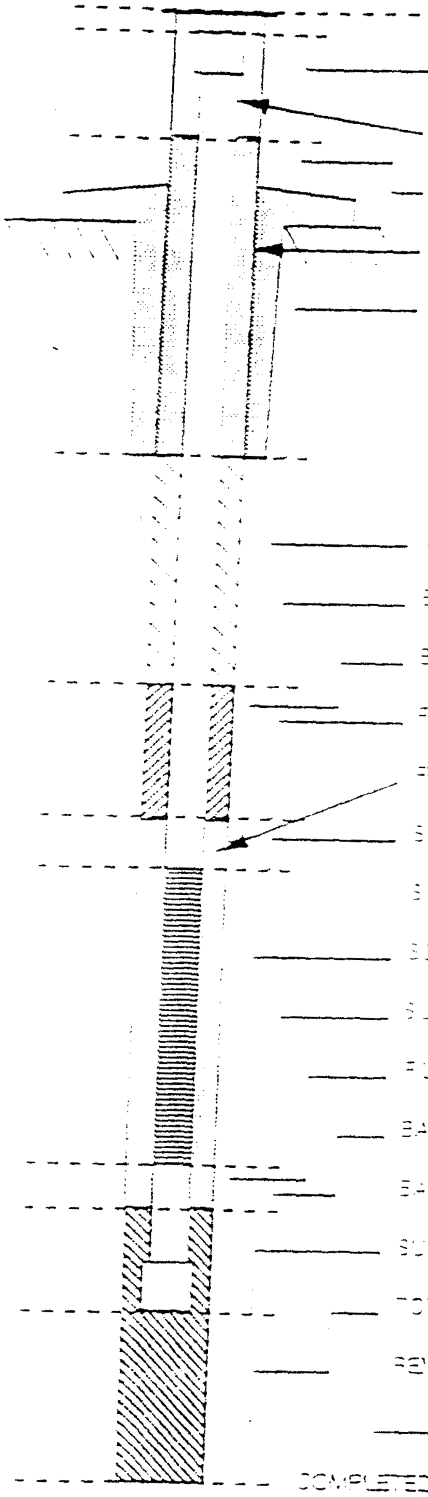
U.S. Department of Energy Rocky Flats Plant

Form GT.58
Rev.3

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21498
PROJECT NAME: N. P.A. Plume
PROGRAM:
SCREENED FORMATION: Qal
DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe
DATE DRILLED: 08-24-98
DATE COMPLETED: 08-24-98
RIG GEOLOGIST: F. Grigsby
LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 11.0'
ESTIMATED DEPTH TO BEDROCK (FT): 9.9'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): Dry
DATE MEASURED: 08-24-98
COMPLETED WATER LEVEL (FT):
DATE MEASURED:



PROTECTIVE CASING, TOP (FT): GL FROM GROUND SURFACE: (Flush Mount)
SURFACE CASING (STICKUP) TOP (FT): -0.4 ~~BGL~~ Flush Mount
SURFACE CASING, I.D. (IN): 0.75 TYPE: PVC
SURFACE SEAL TOP (FT): -1.0' BGL TYPE: Ready Mix Cement
PROTECTIVE CASING, I.D. (IN): 8 TYPE: Metal Flush Mount.
PROTECTIVE CASING, BOTTOM (FT): -1.0' BGL

IF APPLICABLE
SECONDARY CASING, TOP (FT): -0.2' BGL BOTTOM (FT): 2.2' BGL
SECONDARY CASING, I.D. (IN): 2 TYPE: PVC

CENTRALIZER O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL TOP (FT): TYPE:
BENTONITE SEAL TOP (FT): -1.0' BGL TYPE: Bentonite Granules
BENTONITE SEAL BOTTOM (FT): 5.0'
FILTER PACK, TOP (FT): 5.0'
FILTER PACK TYPE: 16-40 - Silica Sd BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 6.0' SCREEN TOP (FT): 6.0'
SCREEN SLOT SIZE (.000 IN): .010 SCREEN I.D. (IN): 0.75
SCREEN BOTTOM (FT): FG ~~11.0~~ 10.7 TYPE: PVC BRAND: CEI
SUMP TOP (FT): FG ~~NA~~ 10.7 TYPE: PVC Cap/Rivet
FILTER PACK, BOTTOM (FT): 11.0'
BACKFILL TOP (FT): 11.0' TYPE: Bentonite Granules
BACKFILL BOTTOM (FT): 15.0'
SUMP BOTTOM (FT): FG ~~NA~~ 11.0'
TOTAL DEPTH (FT): 15.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred Grigsby DATE: 08-25-98

CHECKED BY: DATE:

34539

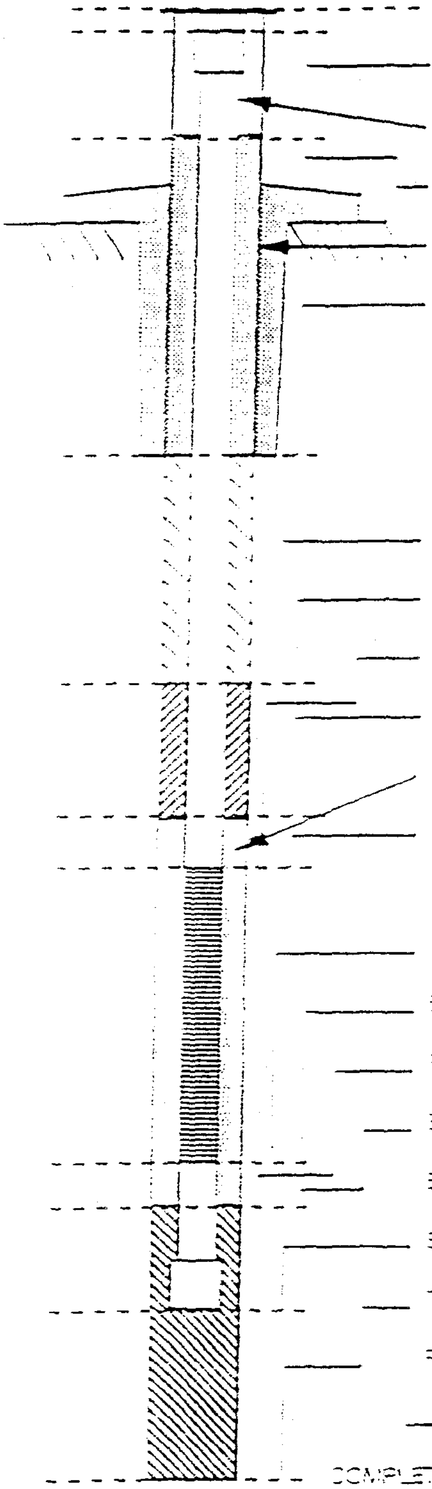
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
Rev.3
[illegible] 2/3/98

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21598'   PROJECT NAME: PA - N. Plume   PROGRAM:
SCREENED FORMATION: Alluvium   DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe - Continuous Core   DATE DRILLED: 8/26/98   DATE COMPLETED: 8/26/
RIG GEOLOGIST: F. Grigsby   LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): ~~15.0'~~ 14.0   ESTIMATED DEPTH TO BEDROCK (FT): 13.0'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): None   DATE MEASURED: 8/26/98
COMPLETED WATER LEVEL (FT):   DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.85'   FROM GROUND SURFACE:
SURFACE CASING (STICKUP) TOP (FT): 0.7'
SURFACE CASING, I.D. (IN): 3/4 in   TYPE: PVC-Sch. 40
SURFACE SEAL TOP (FT): GL   TYPE: Aquaset-Granular Bentonite
PROTECTIVE CASING, I.D. (IN): 2 in   TYPE: PVC Sch. 40
PROTECTIVE CASING, BOTTOM (FT): 1.5'
IF APPLICABLE   SECONDARY CASING, TOP (FT): NA   BOTTOM (FT):
SECONDARY CASING, I.D. (IN): NA   TYPE:
CENTRALIZER, O.D. (IN): NA   TOP (FT):   BOTTOM (FT):
GROUT SEAL TOP (FT): NA   TYPE:
BENTONITE SEAL TOP (FT): GL   TYPE:
BENTONITE SEAL BOTTOM (FT): 5.0'
FILTER PACK TOP (FT): 5.0'
FILTER PACK TYPE: 16-40 Silica Sd.   BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 6.1   SCREEN TOP (FT): 6.1
SCREEN SLOT SIZE (.000 IN): .010 in   SCREEN I.D. (IN): 3/4 in.
SCREEN BOTTOM (FT): 13.7   TYPE: PVC-Sch. 40   BRAND: CEE
SUMP TOP (FT): 13.7'   TYPE: PVC CAP/Rivet
FILTER PACK, BOTTOM (FT): 14.0'
BACKFILL TOP (FT): 14.0   TYPE: Granular Bentonite
BACKFILL BOTTOM (FT): 15.0'
SUMP BOTTOM (FT): 14.0'
TOTAL DEPTH (FT): 15.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred C. Grigsby   DATE: 03-01-99
CHECKED BY: DATE:

548 540

U.S. Department of Energy Rocky Flats Plant

Form GT.68
Rev. ~~3~~
GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: BH21698 PROJECT NAME: North PA Plume PROGRAM: Groundwater

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: TIERRA

DRILLING METHOD: Geoprobe/Push/Hammer DATE DRILLED: 08/27/98 DATE COMPLETED: 08/27/98

RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER

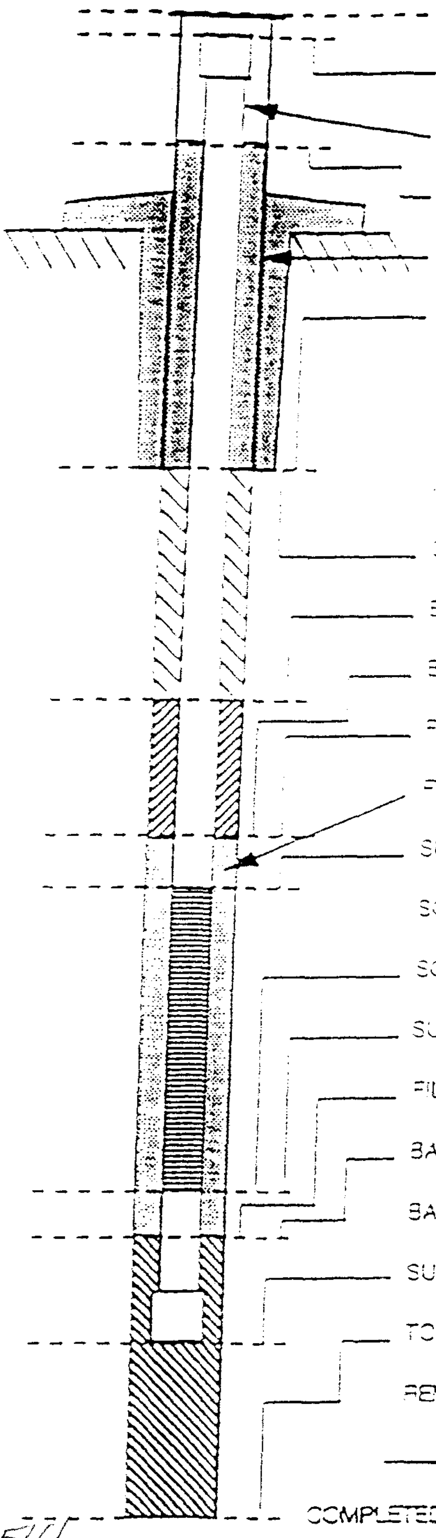
COMPLETED DEPTH (FT): ~~16 ft~~ 15.8 ESTIMATED DEPTH TO BEDROCK (FT): 13 ~~15 ft~~ RRK

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2inch

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): DATE MEASURED:

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 1.2 ft (FROM GROUND SURFACE)

SURFACE CASING (STICKUP), TOP (FT): 0.9 ft.

SURFACE CASING, I.D. (IN): 3/4 inch TYPE: PVC, Sch 40

SURFACE SEAL TOP (FT): Surface TYPE: PDSCo Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 2inch TYPE: PVC, Sch. 40

PROTECTIVE CASING, BOTTOM (FT): 0.8 ft

IF APPLICABLE: SECONDARY CASING, TOP (FT): NA BOTTOM (FT):

SECONDARY CASING, I.D. (IN): NA TYPE:

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): Surface TYPE: PDS Co Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 4.8 ft

FILTER PACK, TOP (FT): 4.8 ft.

FILTER PACK TYPE: 16-40 silica sand BRAND: Colo Silica Sand Inc.

SURFACE CASING, BOTTOM (FT): 5.91 ft SCREEN, TOP (FT): 5.91 ft

SCREEN SLOT SIZE (.000 IN): 0.010 inch SCREEN I.D. (IN): 3/4 inch

SCREEN, BOTTOM (FT): ~~15.3 ft~~ 15.5 Approximately RRK TYPE: PVC, Sch 40 BRAND: NA

SUMP, TOP (FT): ~~15.3 ft~~ 15.5 RRK TYPE: Bottom of Slotted interval to end cap PVC endcap with Pop-Rivets

FILTER PACK, BOTTOM (FT): 15.8 ft

BACKFILL, TOP (FT): 15.8 ft TYPE: PDSCo Granular Bentonite

BACKFILL, BOTTOM (FT): 20 ft.

SUMP, BOTTOM (FT): 15.3 ft

TOTAL DEPTH (FT): 20 ft.

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: R. KOEHLER Robert Koehler DATE: 8/27/98

~~543~~ 541

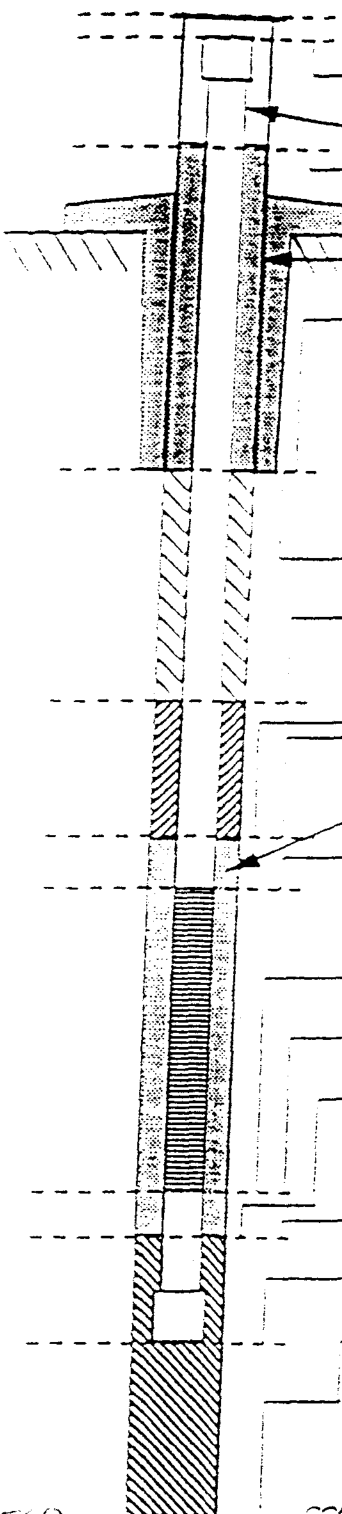
U.S. Department of Energy Rocky Flats Plant

Form GT.58
(Rev.3)
ERR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: BH21798 PROJECT NAME: North PA Plume PROGRAM: Groundwater
SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: TIERRA
DRILLING METHOD: Geoprobe/Push/Hammer DATE DRILLED: 08/31/98 DATE COMPLETED: ~~08/~~ 09/01/9 RPK
RIG GEOLOGIST: R. KOEHLER LOGGING GEOLOGIST: R. KOEHLER
COMPLETED DEPTH (FT): 26.0ft. ESTIMATED DEPTH TO BEDROCK (FT): 24.0ft.
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 inch

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 8/31/98
COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.0ft FROM GROUND SURFACE: - flush mount.
SURFACE CASING (STICKUP), TOP (FT): ±0.5(BGL)
SURFACE CASING, I.D. (IN): 3/4 inch TYPE PVC, sch40
SURFACE SEAL TOP (FT): ±0.7(BGL) TYPE PDS Co. Granular Bentonite
PROTECTIVE CASING, I.D. (IN): 0.82ft TYPE Steel/Cast iron flushmount
PROTECTIVE CASING, BOTTOM (FT): 1.08ft
IF APPLICABLE SECONDARY CASING, TOP (FT): ±0.3(BGL) BOTTOM (FT): 2.3'
SECONDARY CASING, I.D. (IN): 2 inch TYPE PVC sch40
CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL TOP (FT): NA TYPE
BENTONITE SEAL TOP (FT): GL TYPE Granular Bentonite.
BENTONITE SEAL BOTTOM (FT): 15 ft
FILTER PACK, TOP (FT): 15 ft
FILTER PACK TYPE: C.S.S.I. 1640 Silica Sand BRAND: CSSI
SURFACE CASING, BOTTOM (FT): ~~16.1 ft~~ 16.1 SCREEN, TOP (FT): 16.1'
SCREEN SLOT SIZE (.000 IN): 0.010 inch SCREEN I.D. (IN): 3/4 inch
SCREEN, BOTTOM (FT): 25.7' TYPE PVC-sch 40 BRAND: CEI
SUMP, TOP (FT): 25.7' TYPE PVC Cap/Rivet
FILTER PACK, BOTTOM (FT): 26 ft
BACKFILL, TOP (FT): NA TYPE
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 26.0'
TOTAL DEPTH (FT): 26.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

849 5?2

COMPLETED BY: ROBERT KOEHLER [signature] DATE: 08/31/98

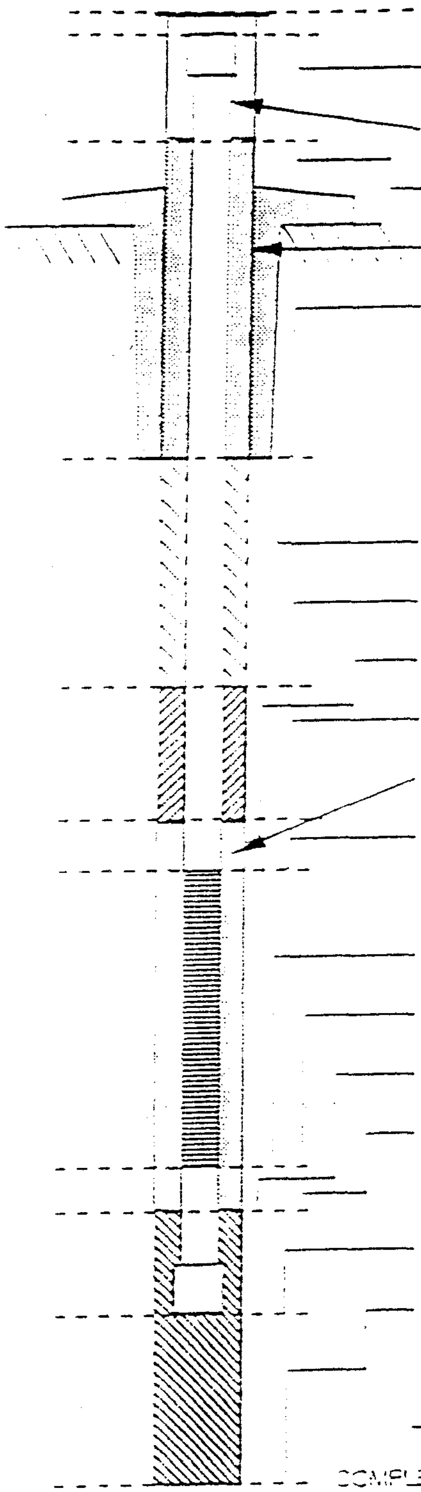
U.S. Department of Energy Rocky Flats Plant

Form GT.3B
Rev.01
GRR 3/3/98

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21898 PROJECT NAME: North PA Plume PROGRAM:
SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe-Continuous Core DATE DRILLED: 9/8/98 DATE COMPLETED: 9/8/98
RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby
COMPLETED DEPTH (FT): 22.0' ESTIMATED DEPTH TO BEDROCK (FT): 18.3'
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA



INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 9/8/98
COMPLETED WATER LEVEL (FT): DATE MEASURED:
PROTECTIVE CASING, TOP (FT): 0.0' FROM GROUND SURFACE: Flush Mount
SURFACE CASING STICKUP, TOP (FT): 0.4' (BGL)
SURFACE CASING, I.D. (IN): 3/4" TYPE: PVC Sch. 40
SURFACE SEAL, TOP (FT): 0.7 (BGL) TYPE: Bentonite Granular
PROTECTIVE CASING, I.D. (IN): 8 in TYPE: Flush Mount
PROTECTIVE CASING, BOTTOM (FT): 1.1'
IF APPLICABLE: SECONDARY CASING, TOP (FT): ±0.3 BGL BOTTOM (FT): 2.3'
SECONDARY CASING, I.D. (IN): 2 in TYPE: PVC-Sch 40
CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): 1.1 TYPE: Augusset Granular Bentonite
BENTONITE SEAL, BOTTOM (FT): 11.0'
FILTER PACK, TOP (FT): 11.0'
FILTER PACK TYPE: 16-40-Silica Sd. BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 12.2' SCREEN, TOP (FT): 12.2
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 21.7 TYPE: PVC-Sch.40 BRAND: CEL
SUMP, TOP (FT): 21.7 TYPE: PVC Cap/Rivet
FILTER PACK, BOTTOM (FT): 22.0'
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 22.0'
TOTAL DEPTH (FT): 22.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE

REMARKS:

COMPLETED BY: Fred Grigsby F. Grigsby DATE: 3/11/99

CHECKED BY: DATE:

~~545~~ 543

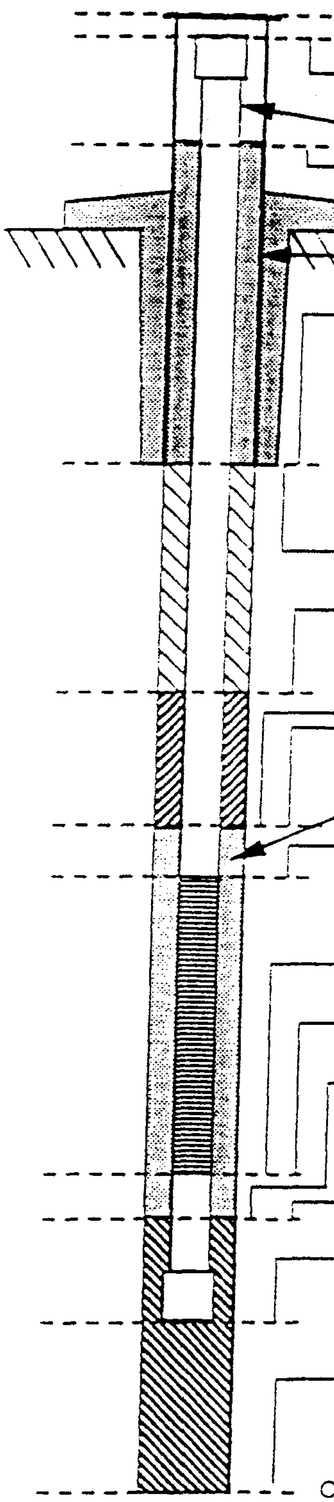
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 21998 PROJECT NAME: North PA Plume PROGRAM:
SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe - Continuous Core DATE DRILLED: 9/1/98 DATE COMPLETED: 9/1/98
RIG GEOLOGIST: R. Koehler LOGGING GEOLOGIST: R. Koehler
COMPLETED DEPTH (FT): 20.0' ESTIMATED DEPTH TO BEDROCK (FT): NA
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2"

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA
INITIAL WATER LEVEL (FT): Dry DATE MEASURED: 9/1/98
COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.0 (FROM GROUND SURFACE) Flush Mount
SURFACE CASING (STICKUP), TOP (FT): ± 0.4 (BGL)
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40
SURFACE SEAL, TOP (FT): -0.7 TYPE: Bentonite - granular
PROTECTIVE CASING, I.D. (IN): 8 in TYPE: Flush Mount.
PROTECTIVE CASING, BOTTOM (FT): 1.1 (BGL)

IF APPLICABLE
SECONDARY CASING, TOP (FT): -0.3 ± (BGL) BOTTOM (FT): 2.3'
SECONDARY CASING, I.D. (IN): 2" TYPE: PVC - Sch. 40

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): -0.7 ± TYPE: PDS Co granular Bentonite
BENTONITE SEAL, BOTTOM (FT): 11.5'
FILTER PACK, TOP (FT): 11.5'
FILTER PACK TYPE: 16-40 Silica Sd. BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 12.2 SCREEN, TOP (FT): 12.2
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.
SCREEN, BOTTOM (FT): 19.7 TYPE: PVC - Sch. 40 BRAND: CEE
SUMP, TOP (FT): 19.7 TYPE: PVC Cap/Rivet
FILTER PACK, BOTTOM (FT): 20.0'
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 20.0'
TOTAL DEPTH (FT): 20.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Robert Koehler DATE: 3/1/99
CHECKED BY: Fred Grigsby DATE: 3/1/99

~~546~~ 544

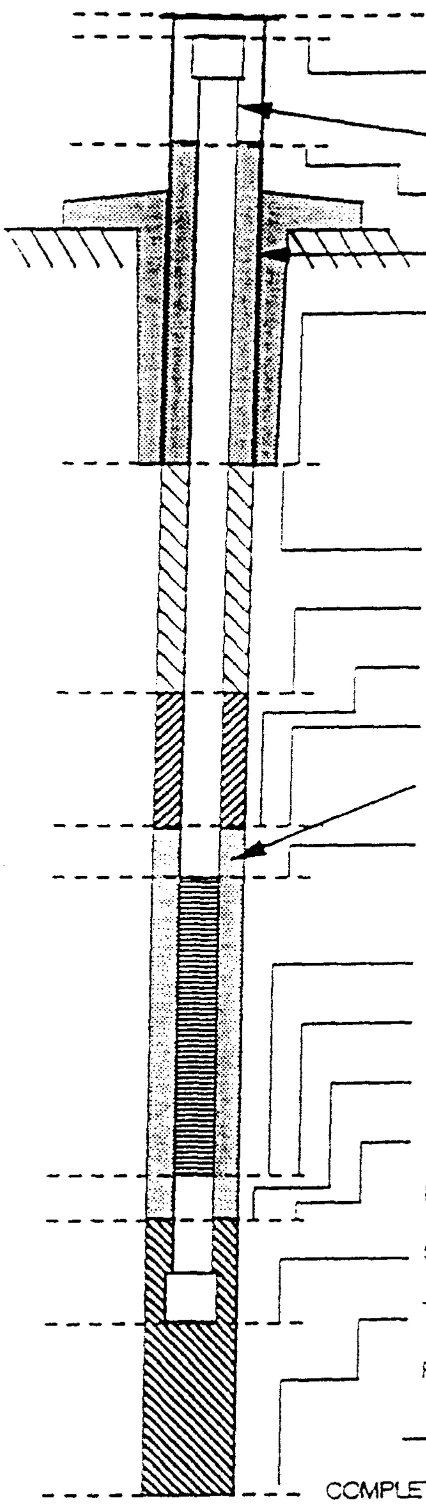
U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3) ORR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 22098 PROJECT NAME: North PA Plume PROGRAM:
SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra
DRILLING METHOD: Geoprobe - Continuous Core DATE DRILLED: 9/2/99 DATE COMPLETED: 9/3/99
RIG GEOLOGIST: R. Koehler, J. Boylan LOGGING GEOLOGIST: R. Koehler, J. Boylan
COMPLETED DEPTH (FT): 25.0' ESTIMATED DEPTH TO BEDROCK (FT): Unknown
BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA.
INITIAL WATER LEVEL (FT): None DATE MEASURED: 9/3/99
COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): GL (FROM GROUND SURFACE) Flush Mount
SURFACE CASING (STICKUP), TOP (FT): 0.4' (BGL)
SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC Sch. 40
SURFACE SEAL, TOP (FT): -0.7 TYPE: Granular Bentonite
PROTECTIVE CASING, I.D. (IN): 8 in. TYPE: Flush Mount.
PROTECTIVE CASING, BOTTOM (FT): 1.1
IF APPLICABLE SECONDARY CASING, TOP (FT): 0.2 (BGL) BOTTOM (FT): 2.2'
SECONDARY CASING, I.D. (IN): 2 in TYPE: PVC Sch 40
CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):
GROUT SEAL, TOP (FT): NA TYPE:
BENTONITE SEAL, TOP (FT): GL TYPE: Granular Bentonite
BENTONITE SEAL, BOTTOM (FT): 6.5'
FILTER PACK, TOP (FT): 6.5'
FILTER PACK TYPE: 16-40 - Silica Sd BRAND: CSSI
SURFACE CASING, BOTTOM (FT): 10.4' SCREEN, TOP (FT): 10.4'
SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4"
SCREEN, BOTTOM (FT): 24.7 TYPE: PVC Sch 40 BRAND: CEI
SUMP, TOP (FT): 24.7 TYPE: PVC Cap/Rivet
FILTER PACK, BOTTOM (FT): 25.0'
BACKFILL, TOP (FT): NA TYPE:
BACKFILL, BOTTOM (FT): NA
SUMP, BOTTOM (FT): 25.0'
TOTAL DEPTH (FT): 25.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Robert Koehler DATE: 3/1/99
CHECKED BY: Fred Grigsby DATE: 3/1/99

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U.S. Department of Energy Rocky Flats Plant

Form GT.6B
(Rev.3)
GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 22198 PROJECT NAME: North PA Plume PROGRAM:

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra

DRILLING METHOD: Geoprobe – Continuous Core DATE DRILLED: 9/9/98 DATE COMPLETED: 9/10/98

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

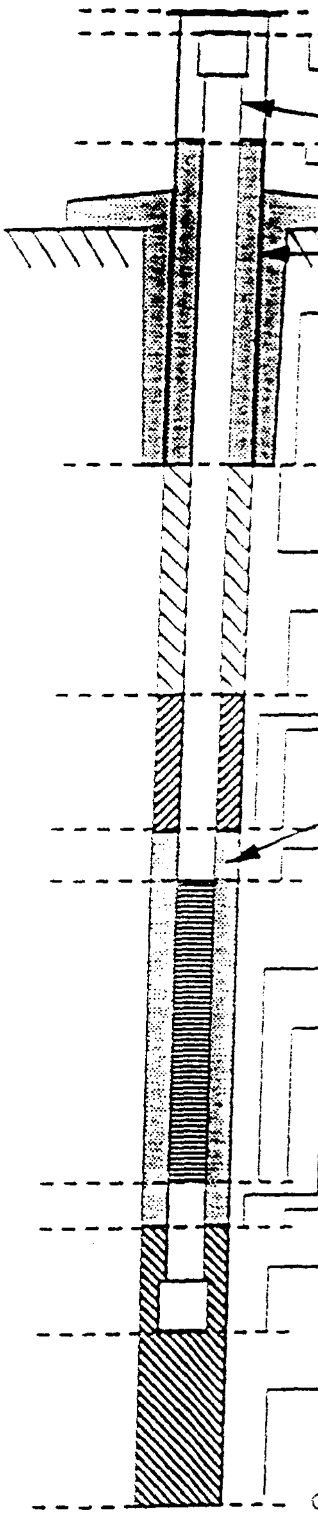
COMPLETED DEPTH (FT): ~~20.0~~ 17.6 ESTIMATED DEPTH TO BEDROCK (FT): Unknown

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL): NA

INITIAL WATER LEVEL (FT): ~~13.3'~~ 11.07 DATE MEASURED: 9/10/98

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.0' FROM GROUND SURFACE: Flush Mount

SURFACE CASING (STICKUP), TOP (FT): ± 0.4' (BGL)

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch 40

SURFACE SEAL TOP (FT): ± 0.7 TYPE: Granular Bentonite.

PROTECTIVE CASING, I.D. (IN): 8 in TYPE: Flush Mount.

PROTECTIVE CASING, BOTTOM (FT): 1.1'

IF APPLICABLE SECONDARY CASING, TOP (FT): ± 0.2'(BGL) BOTTOM (FT): 2.2'

SECONDARY CASING, I.D. (IN): 2 in TYPE: PVC - Sch. 40

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): GL TYPE: Aquaset - Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 6.5'

FILTER PACK, TOP (FT): 6.5'

FILTER PACK TYPE: 16-40 Silica Sd BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 7.6' SCREEN, TOP (FT): 7.6'

SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in

SCREEN, BOTTOM (FT): 17.2 TYPE: PVC - Sch. 40 BRAND: CEI

SUMP, TOP (FT): 17.2 TYPE: PVC Cap/Rivet.

FILTER PACK, BOTTOM (FT): 17.57

BACKFILL, TOP (FT): 17.57 TYPE: Natural - Alluvium

BACKFILL, BOTTOM (FT): 20.0'

SUMP, BOTTOM (FT): 17.57'

TOTAL DEPTH (FT): 20.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred C. Grigsby [signature] DATE: 3/1/99

CHECKED BY: DATE:

~~548~~ 546

U.S. Department of Energy Rocky Flats Plant

Form GT.58 (Rev.3) GRR 3/31/94

Groundwater Monitoring Well and Piezometer Report

LOCATION CODE: 22298 PROJECT NAME: North PA Plume PROGRAM:

SCREENED FORMATION: Alluvium DRILLING CONTRACTOR: Tierra

DRILLING METHOD: Geoprobe - Continuous Core DATE DRILLED: 9/14/98 DATE COMPLETED: 9/23/98

RIG GEOLOGIST: F. Grigsby LOGGING GEOLOGIST: F. Grigsby

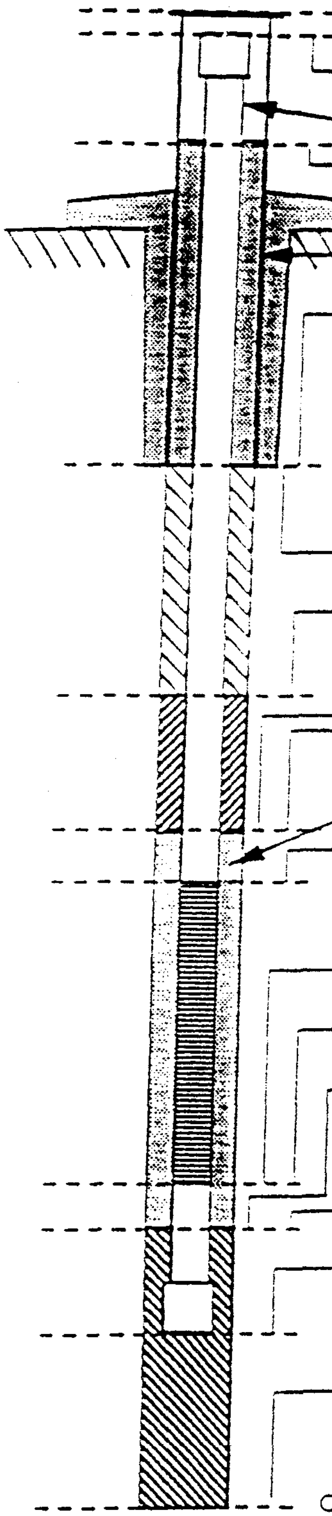
COMPLETED DEPTH (FT): ~~20.0~~ 16.4 ESTIMATED DEPTH TO BEDROCK (FT): 16.6'

BOREHOLE DIAMETER IN SCREENED INTERVAL (IN): 2 in.

QUANTITY OF FLUIDS LOST DURING DRILLING (GAL):

INITIAL WATER LEVEL (FT): ? DATE MEASURED: 9/14/98

COMPLETED WATER LEVEL (FT): DATE MEASURED:



PROTECTIVE CASING, TOP (FT): 0.0' FROM GROUND SURFACE: Flush Mount

SURFACE CASING (STICKUP), TOP (FT): -0.4' (BGL)

SURFACE CASING, I.D. (IN): 3/4 in TYPE: PVC - Sch. 40

SURFACE SEAL TOP (FT): -0.7' TYPE: Granular Bentonite

PROTECTIVE CASING, I.D. (IN): 8 in TYPE: Flush Mount

PROTECTIVE CASING, BOTTOM (FT): -1.1

IF APPLICABLE: SECONDARY CASING, TOP (FT): ±0.2 (BGL) BOTTOM (FT): ±2.2'

SECONDARY CASING, I.D. (IN): 2 in TYPE: PVC Sch. 40

CENTRALIZER, O.D. (IN): NA TOP (FT): BOTTOM (FT):

GROUT SEAL TOP (FT): NA TYPE:

BENTONITE SEAL TOP (FT): 1.1' TYPE: Granular Bentonite

BENTONITE SEAL BOTTOM (FT): 5.5'

FILTER PACK, TOP (FT): 5.5'

FILTER PACK TYPE: 16-40 Silica Sd BRAND: CSSI

SURFACE CASING, BOTTOM (FT): 6.5' SCREEN, TOP (FT): 6.5'

SCREEN SLOT SIZE (.000 IN): .010 in SCREEN, I.D. (IN): 3/4 in.

SCREEN, BOTTOM (FT): 16.1 TYPE: PVC Sch. 40 BRAND: CEE

SUMP, TOP (FT): 16.1 TYPE: PVC cap/Rivet

FILTER PACK, BOTTOM (FT): 16.4'

BACKFILL, TOP (FT): 16.4' TYPE: Granular Bentonite

BACKFILL, BOTTOM (FT): ~~16.4~~ 20.0'

SUMP, BOTTOM (FT): 16.4'

TOTAL DEPTH (FT): 20.0'

ALL MEASUREMENTS WILL BE MADE FROM GROUND SURFACE.

REMARKS:

COMPLETED BY: Fred Grigsby DATE: 3/1/99

CHECKED BY: DATE:

549/549 547/547

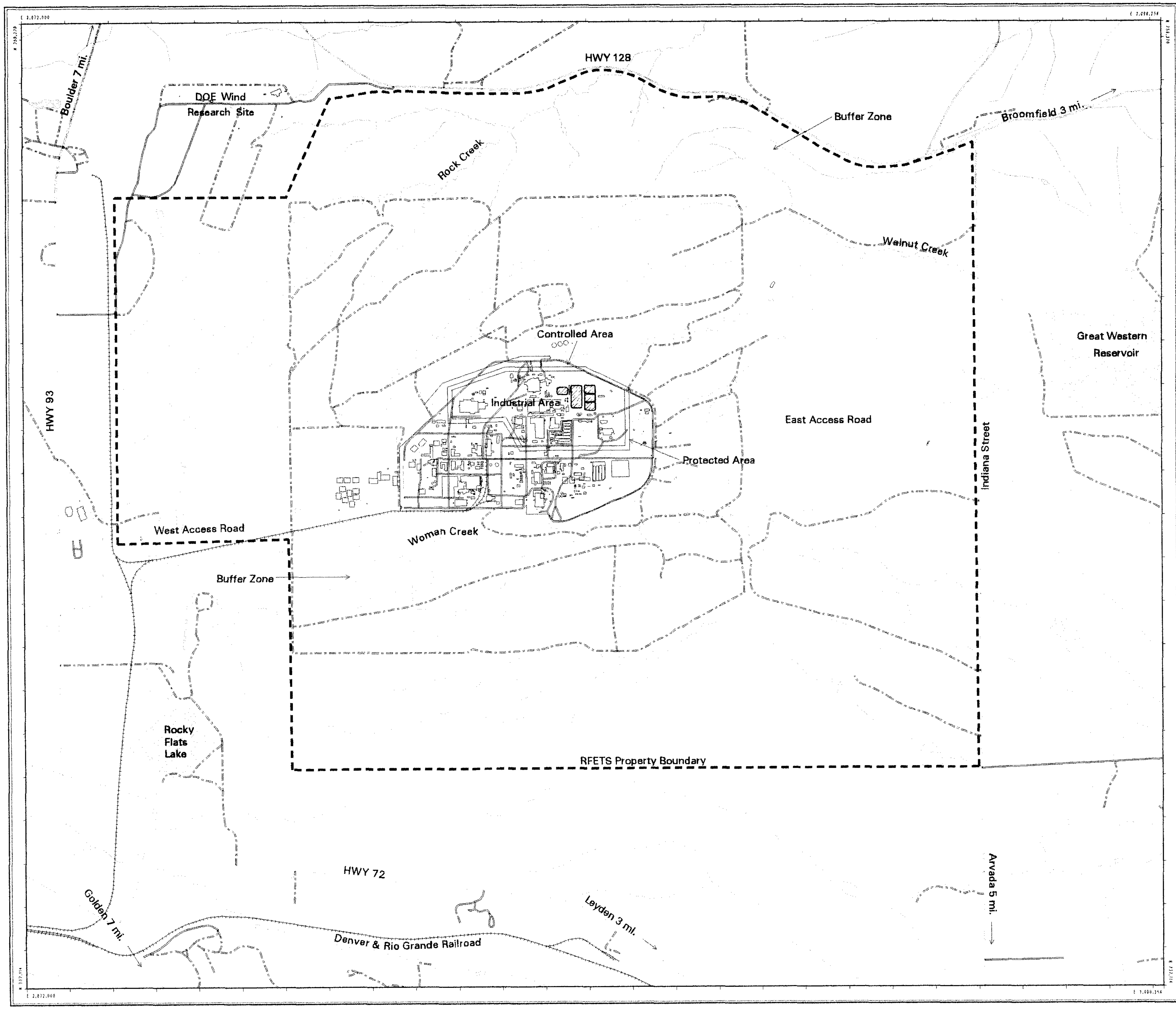


Figure 1-2

Rocky Flats Environmental Technology Site Map

EXPLANATION

Standard Map Features

- Buildings
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences
- Rocky Flats boundary
- Heavy duty paved roads
- Medium duty paved roads
- Light duty paved roads
- Dirt roads
- Railroads

DATA SOURCE: Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

N

Scale = 1 : 28720
1 inch represents approximately 2393 feet

700 0 1400 2800ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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Geographic Information Systems Group
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Golden, CO 80402-0464

MAP ID: 97-0063 September 27, 1999

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11

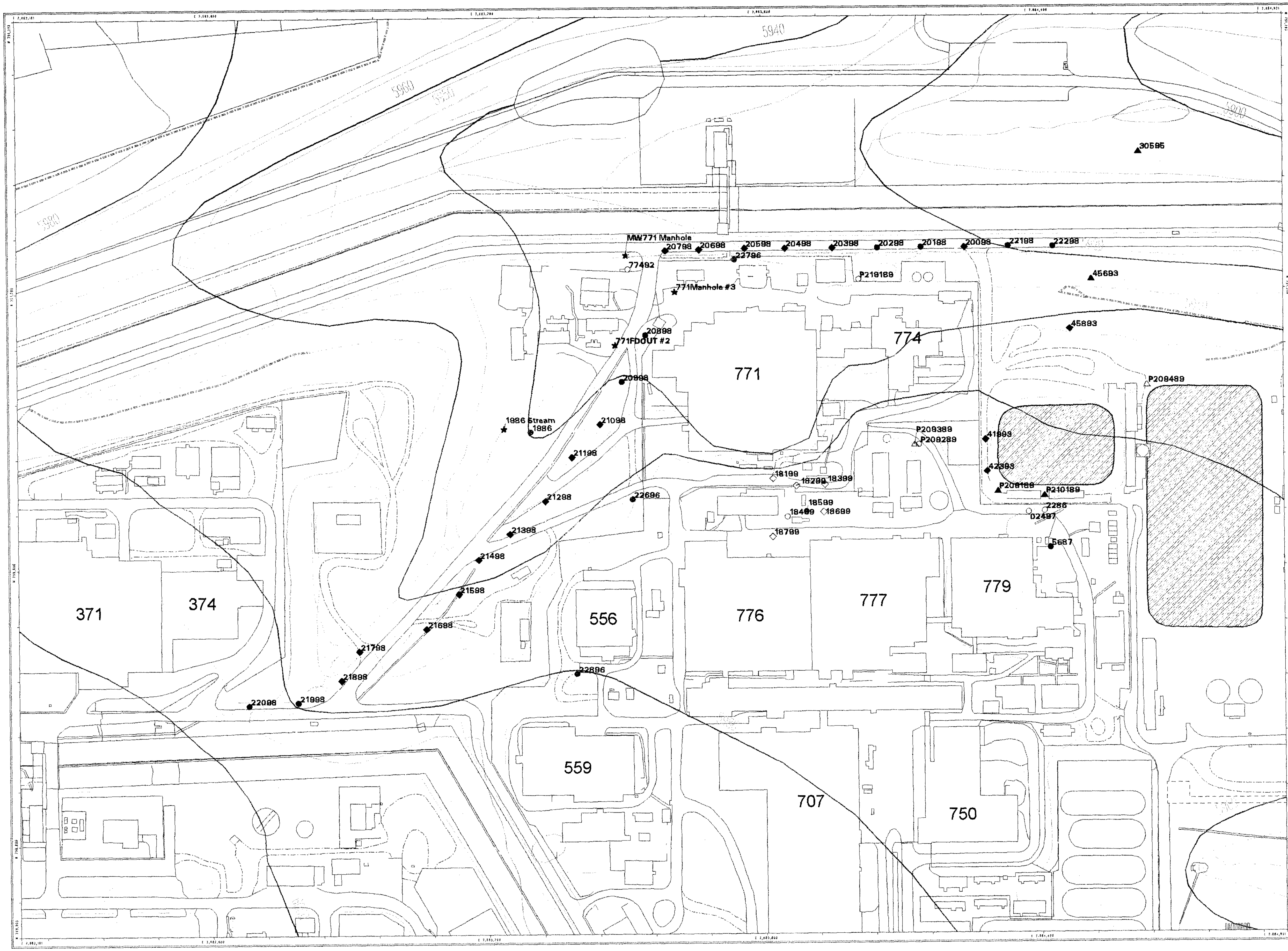

Figure 4-1
North Industrial Area
Potentiometric Surface

Well Classifications
- Plume Definition
- Plume Extent
- Building D&D
- Water Level
- Non-IMP

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells
- Surface Water Monitoring Locations

Potentiometric Surface Contours - Fall 1998
- Water Level Contour
- Dashed where inferred
- Intermediate Water Level Contour
- Dashed where inferred
- Approximate extent of Unsaturated Area

Standard Map Features
- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 2590
1 inch represents approximately 216 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0365

September 27, 1999

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130

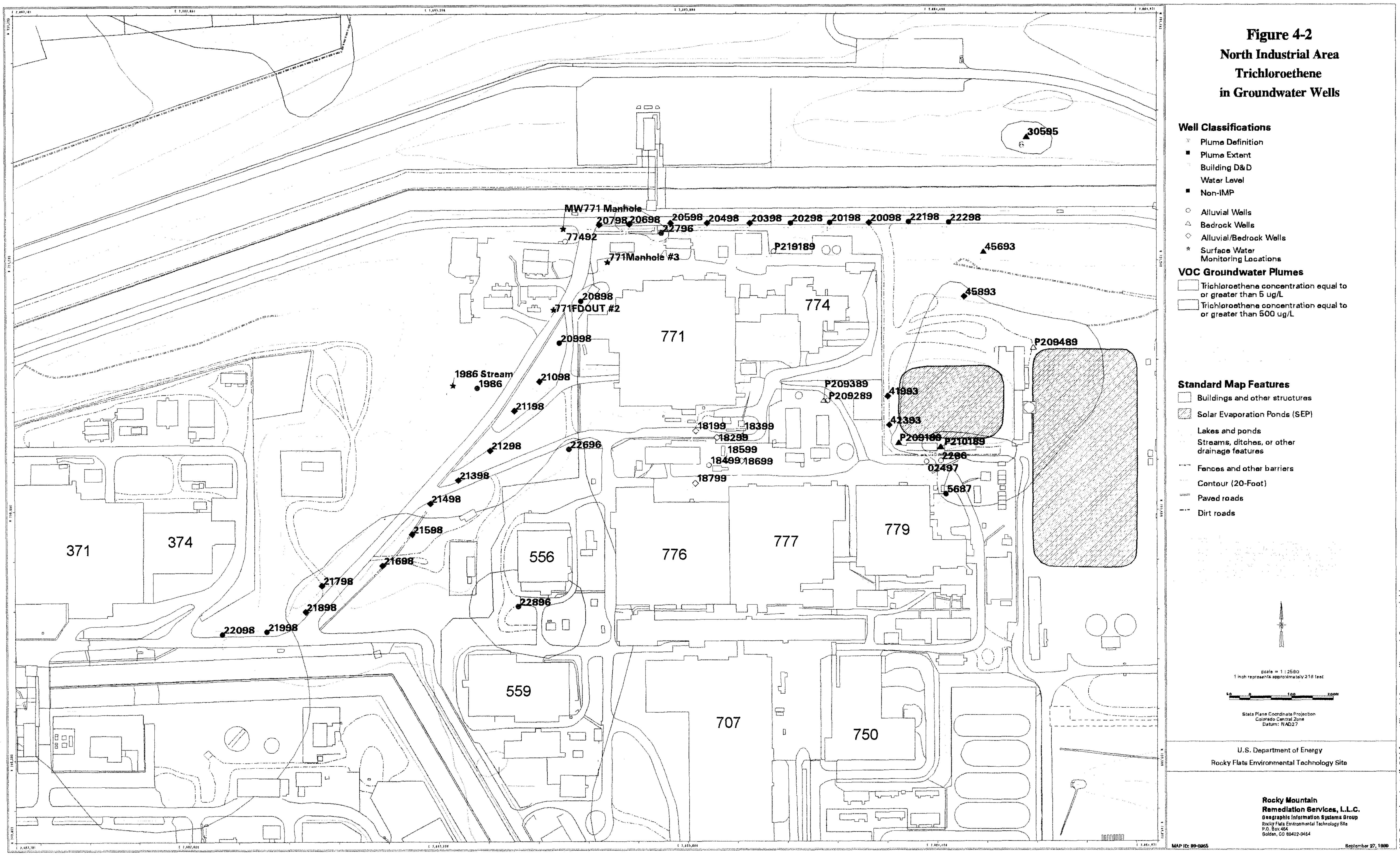
Figure 4-2
North Industrial Area
Trichloroethene
in Groundwater Wells
Well Classifications
Plume Definition
Plume Extent
Building D&D
Water Level
Non-IMP
Alluvial Wells
Bedrock Wells
Alluvial/Bedrock Wells
Surface Water Monitoring Locations
VOC Groundwater Plumes
Trichloroethene concentration equal to or greater than 5 ug/L
Trichloroethene concentration equal to or greater than 500 ug/L
Standard Map Features
Buildings and other structures
Solar Evaporation Ponds (SEP)
Lakes and ponds
Streams, ditches, or other drainage features
Fences and other barriers
Contour (20-Foot)
Paved roads
Dirt roads
Scale = 1 : 2580
1 inch represents approximately 216 feet
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27
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Geographic Information Systems Group
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MAP ID: 99-0365
September 27, 1999
NT_Svr w:/projects/fy99/rfca-rpt/ihss118_voos/figure4-2.voo=trichloro-
771
774
776
777
779
707
750
556
559
371
374
30595
45693
45893
P209489
P219189
P209389
P209289
41993
42393
P209189
P210189
2286
02497
5687
MW771 Manhole
20798
20698
20598
20498
20398
20298
20198
20098
22198
22298
22796
77492
771Manhole #3
20898
771FDOUT #2
20998
1986 Stream
1986
21098
21198
21298
21398
21498
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18499
18699
18799

133

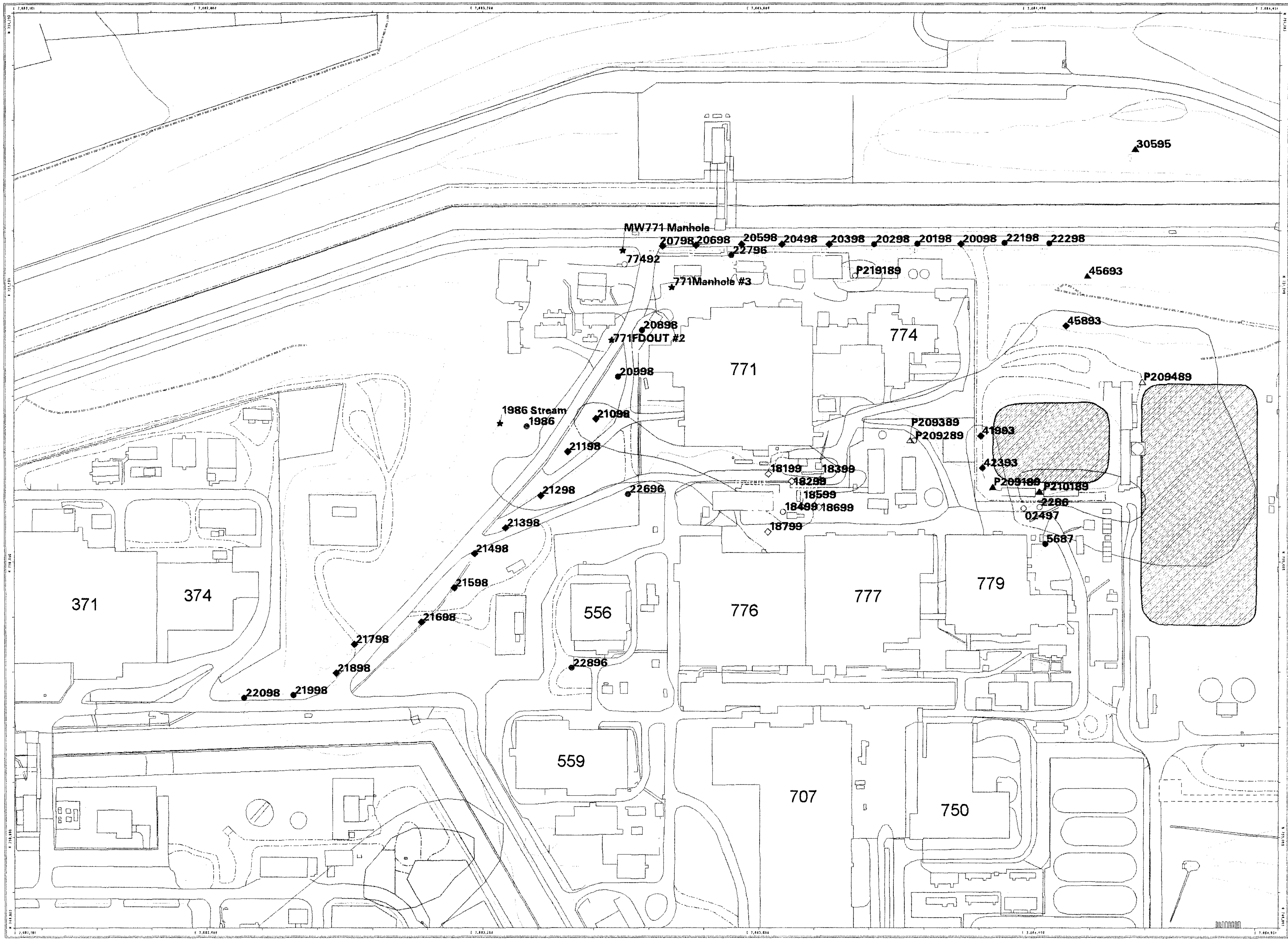

Figure 4-3
North Industrial Area Carbon Tetrachloride in Groundwater Wells

Well Classifications
- Plume Definition
- Plume Extent
- Building D&D
- Water Level
- Non-IMP
- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells
- Surface Water Monitoring Locations

VOC Groundwater Plumes
- Carbon Tetrachloride concentration equal to or greater than 5 ug/L
- Carbon Tetrachloride concentration equal to or greater than 500 ug/L

Standard Map Features
- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 2590
1 inch represents approximately 216 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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174

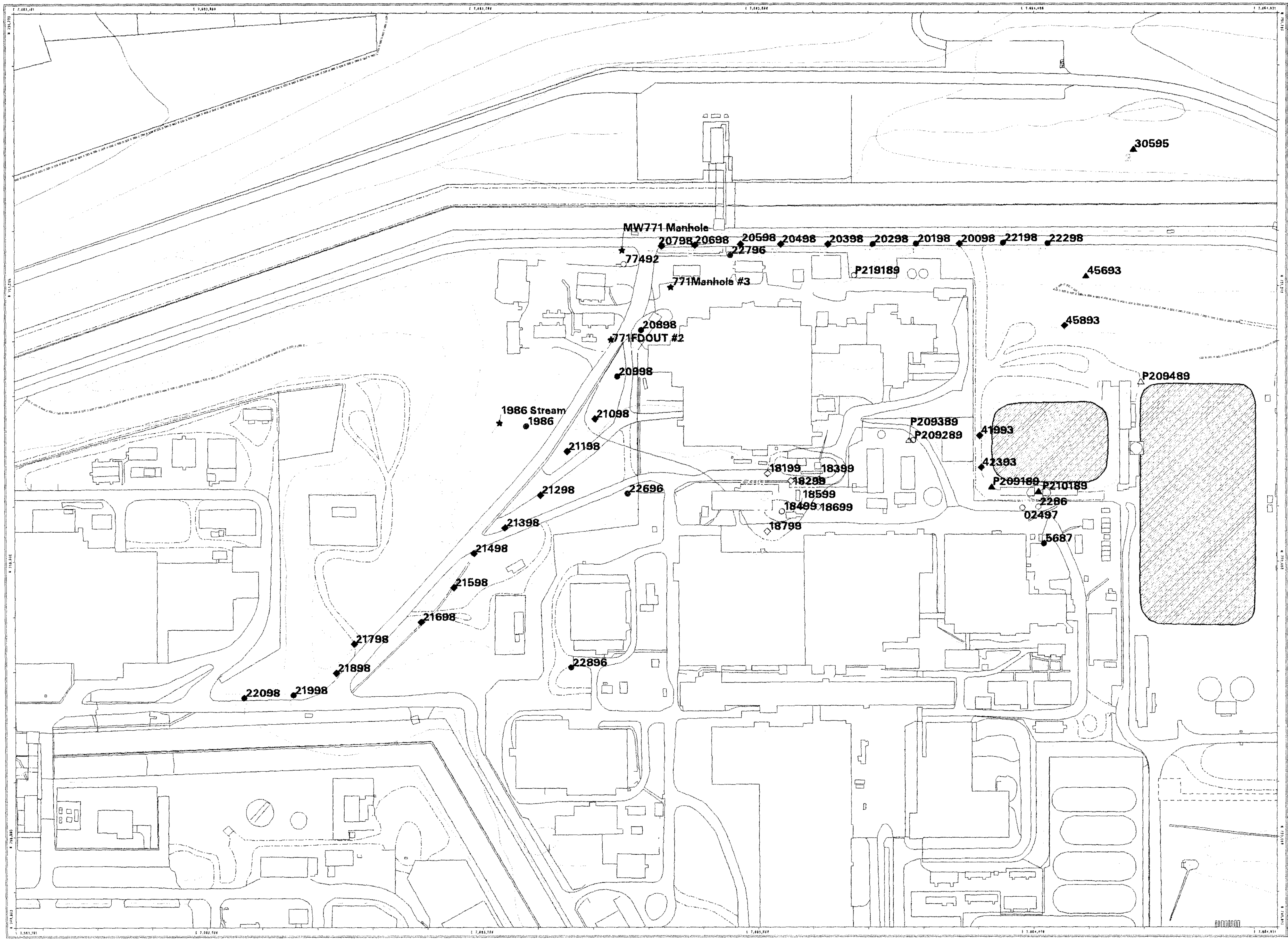

Figure 4-4
North Industrial Area
Chloroform
in Groundwater Wells

Well Classifications

- Plume Definition
- Plume Extent
- Building D&D
- Water Level
- Non-IMP
- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells
- Surface Water Monitoring Locations

VOC Groundwater Plumes

- Chloroform concentration equal to or greater than 100 ug/L
- Chloroform concentration equal to or greater than 10000 ug/L

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 2580
1 inch represents approximately 216 feet

State Plane Coordinate Projection
Colorado Central Zone
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135

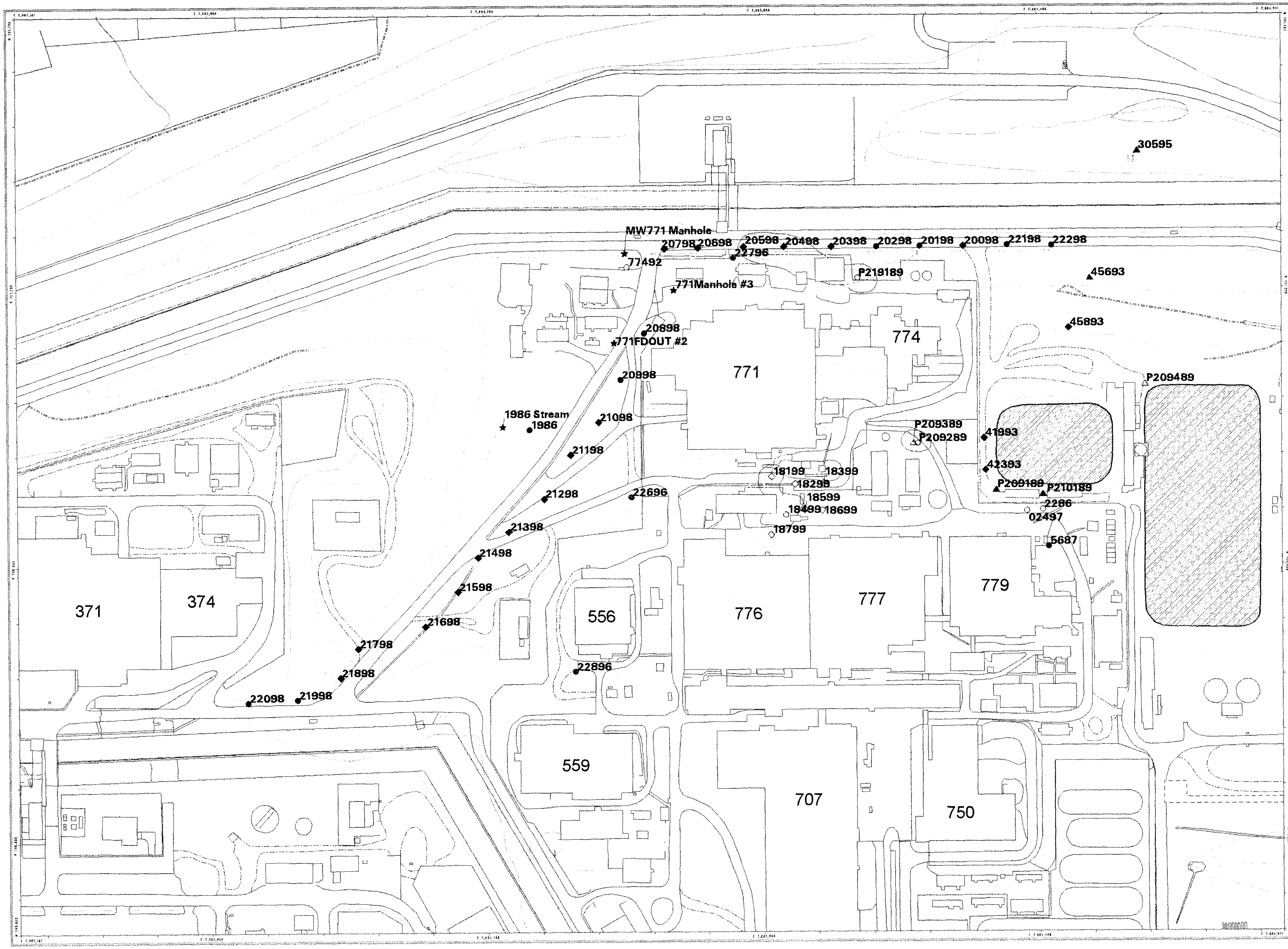

Figure 4-5
North Industrial Area 1,1-Dichloroethene in Groundwater Wells

Well Classifications
- Plume Definition
- Plume Extent
- Building D&D
- Water Level
- Non-IMP
- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells
- Surface Water Monitoring Locations

VOC Groundwater Plumes
- 1,1-Dichloroethene concentration equal to or greater than 7 ug/L

Standard Map Features
- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 2590
1 inch represents approximately 216 feet

State Plane Coordinate Projection
Colorado Central Zone
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MAP ID: 99-0085

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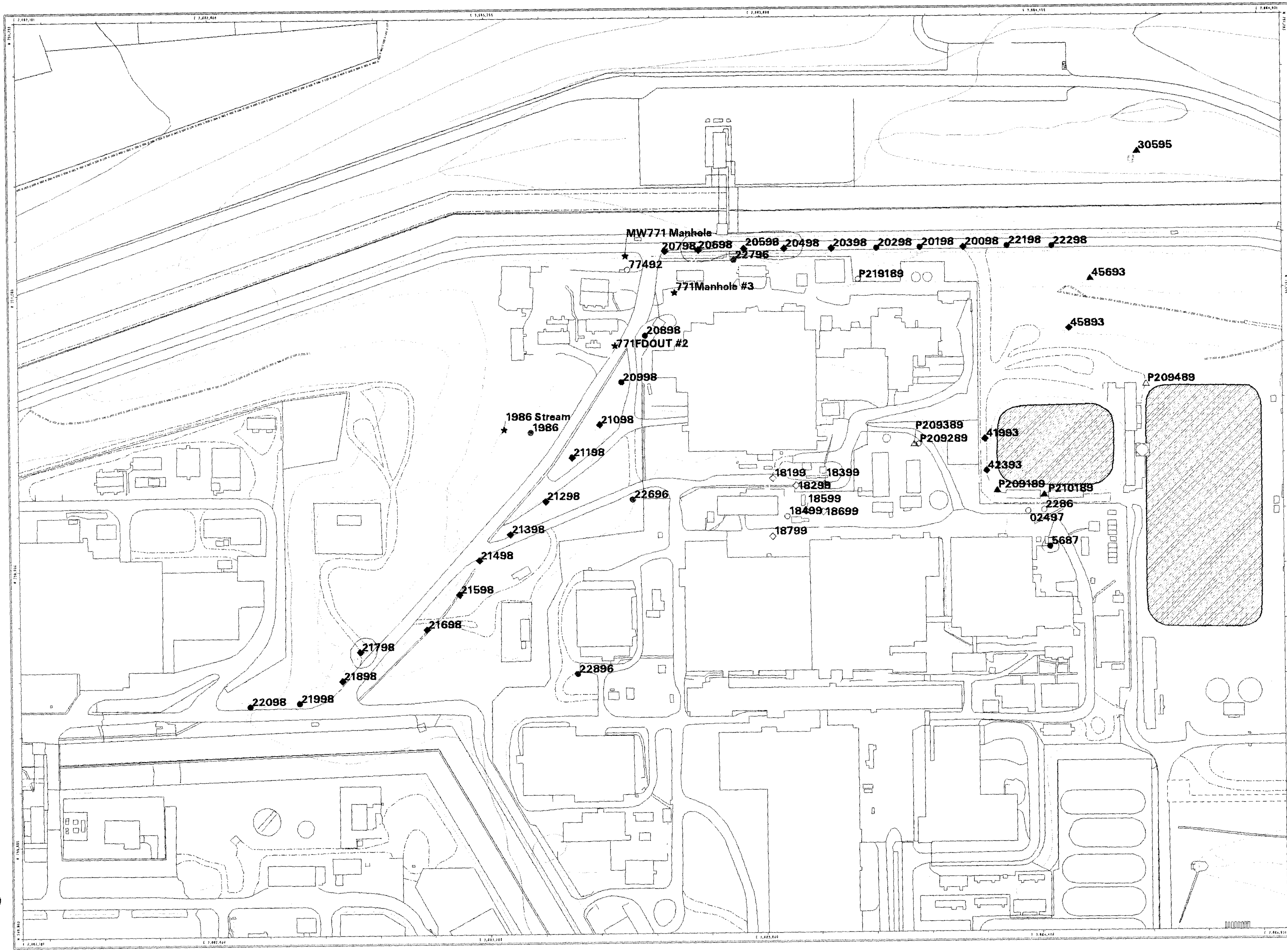
NT_Svr w:/projects/fy99/rfca-rpt/hss118_vocs/figure4-5.voc-di-ethene

136

Figure 4-6
North Industrial Area Vinyl Chloride in Groundwater Wells



Well Classifications
- Plume Definition
- Plume Extent
- Building D&D
- Water Level
- Non-IMP
- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells
- Surface Water Monitoring Locations

VOC Groundwater Plumes
- Vinyl Chloride concentration equal to or greater than 2 ug/L
- Vinyl Chloride concentration equal to or greater than 200 ug/L

Standard Map Features
- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 2580
1 inch represents approximately 210 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0365

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137

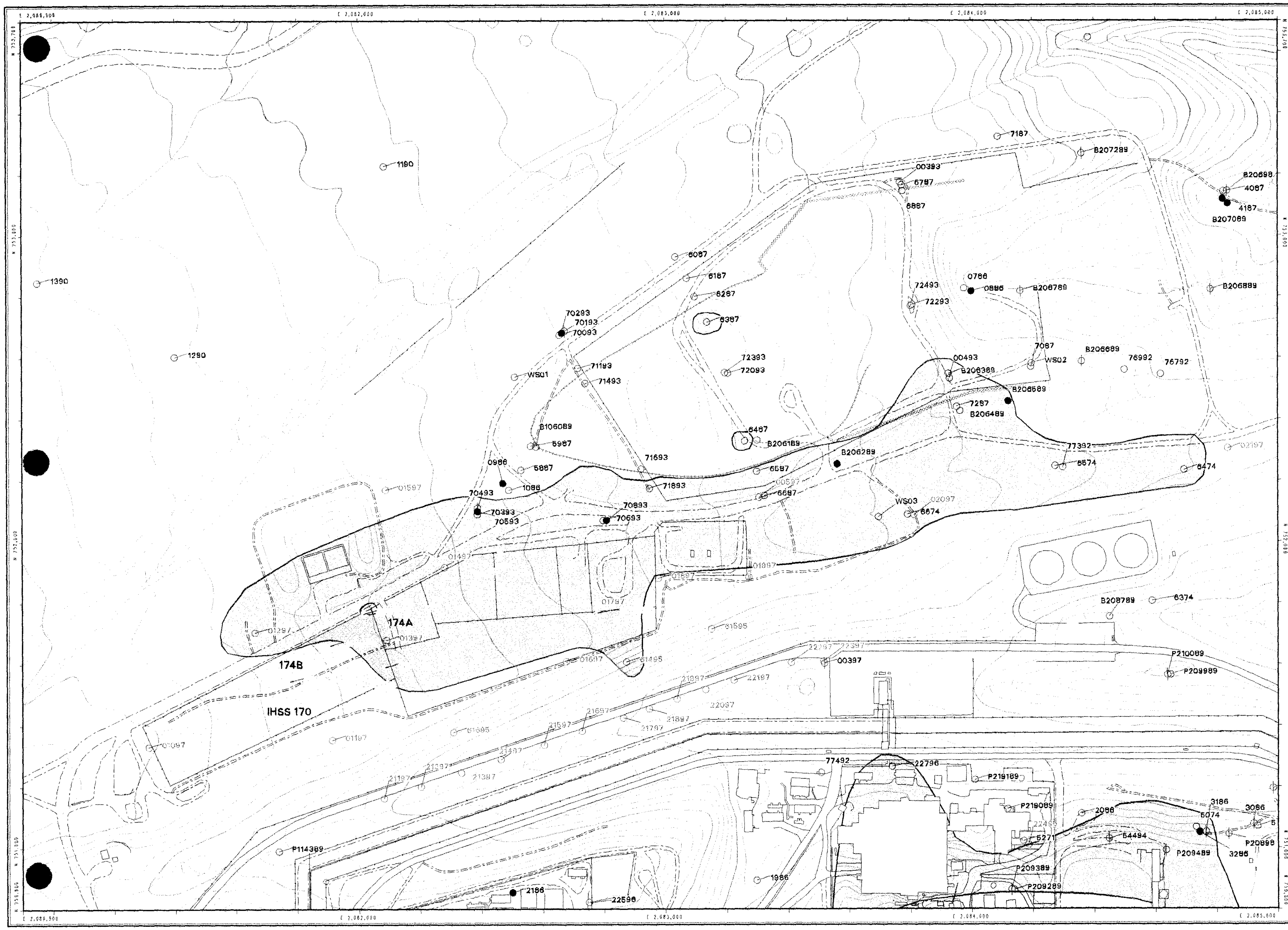

Figure 4-7
PU&D Yard 1997
Groundwater VOC Plume

EXPLANATION

- PU&D Yard Monitoring Well
- Groundwater Monitor Well UHSU Surficial Material
- Groundwater Monitor Well UHSU Bedrock
- Groundwater Monitor Well LHSU Bedrock
- Borehole Locations
- Groundwater Intercept System
- Landfill Slurry wall
- Composite VOC Groundwater Plume (100 X MCL)
- Composite VOC Groundwater Plume (concentration equal to MCL)
- PU&D Yard IHSS

Standard Map Features

- Buildings and other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 3810
1 inch represents approximately 318 feet

100 0 200 400ft

State Plane Coordinate Projection
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MAP ID: 99-0440

September 27, 1999

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143

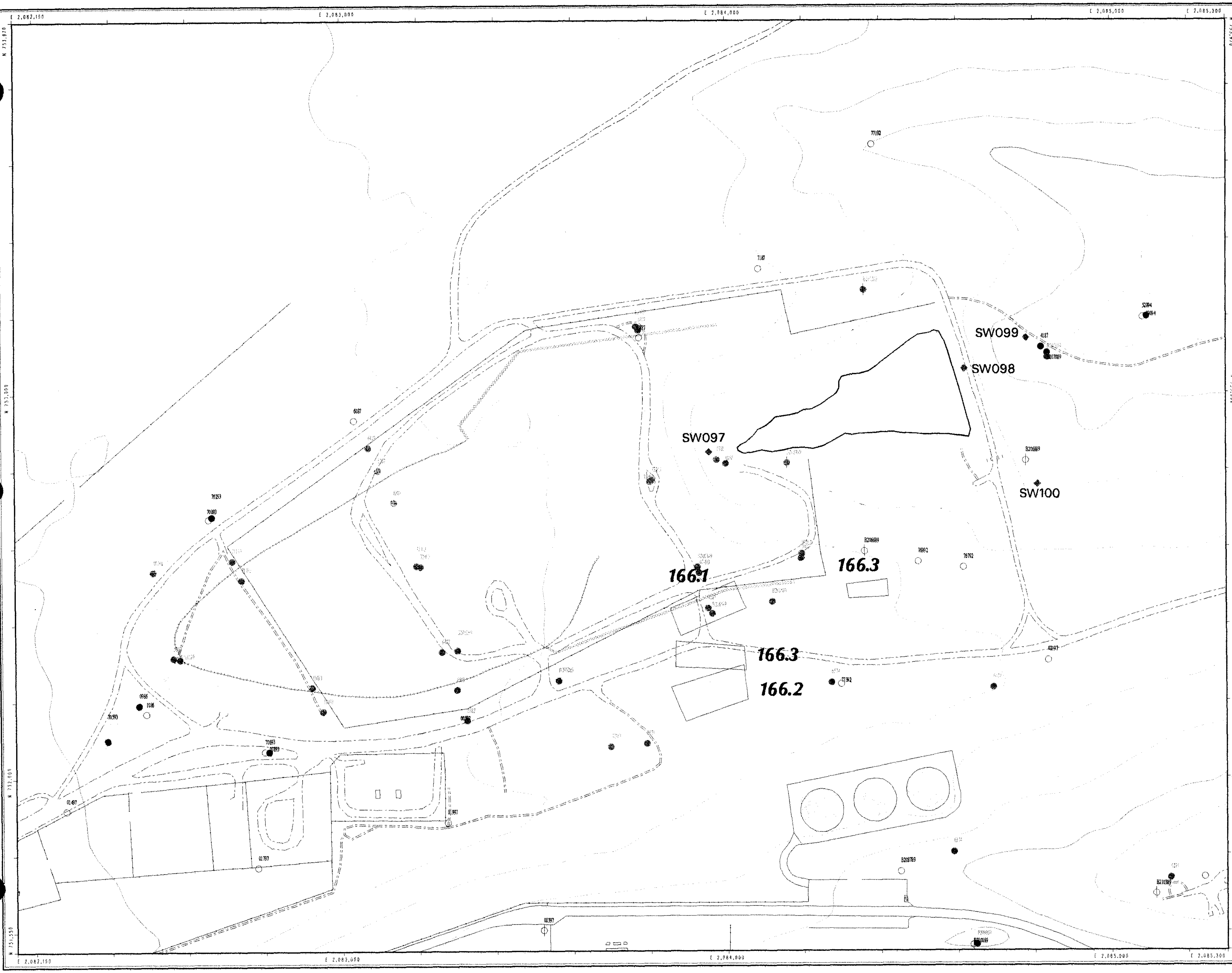

Figure 4-8

Groundwater Intercept and Diversion System Layout at the Present Sanitary Landfill 1998

EXPLANATION

- Groundwater Monitor Well UHSU Surficial Material
- Groundwater Monitor Well UHSU Bedrock
- Groundwater Monitor Well LHSU Bedrock
- Surface Water Monitoring Locations
- Landfill Groundwater Monitoring Wells
- All Other Existing Wells
- Abandoned Wells
- IHSS 166.1, 166.2 and 166.3
- Slurry Wall
- GW Intercept System - Perforated
- GW Intercept System - Non-Perforated
- Individual Hazardous Substance Site
- East Landfill Pond
- Tanks
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 2930
1 inch represents approximately 244 feet

100 0 200 400ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0266 September 27, 1999

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146

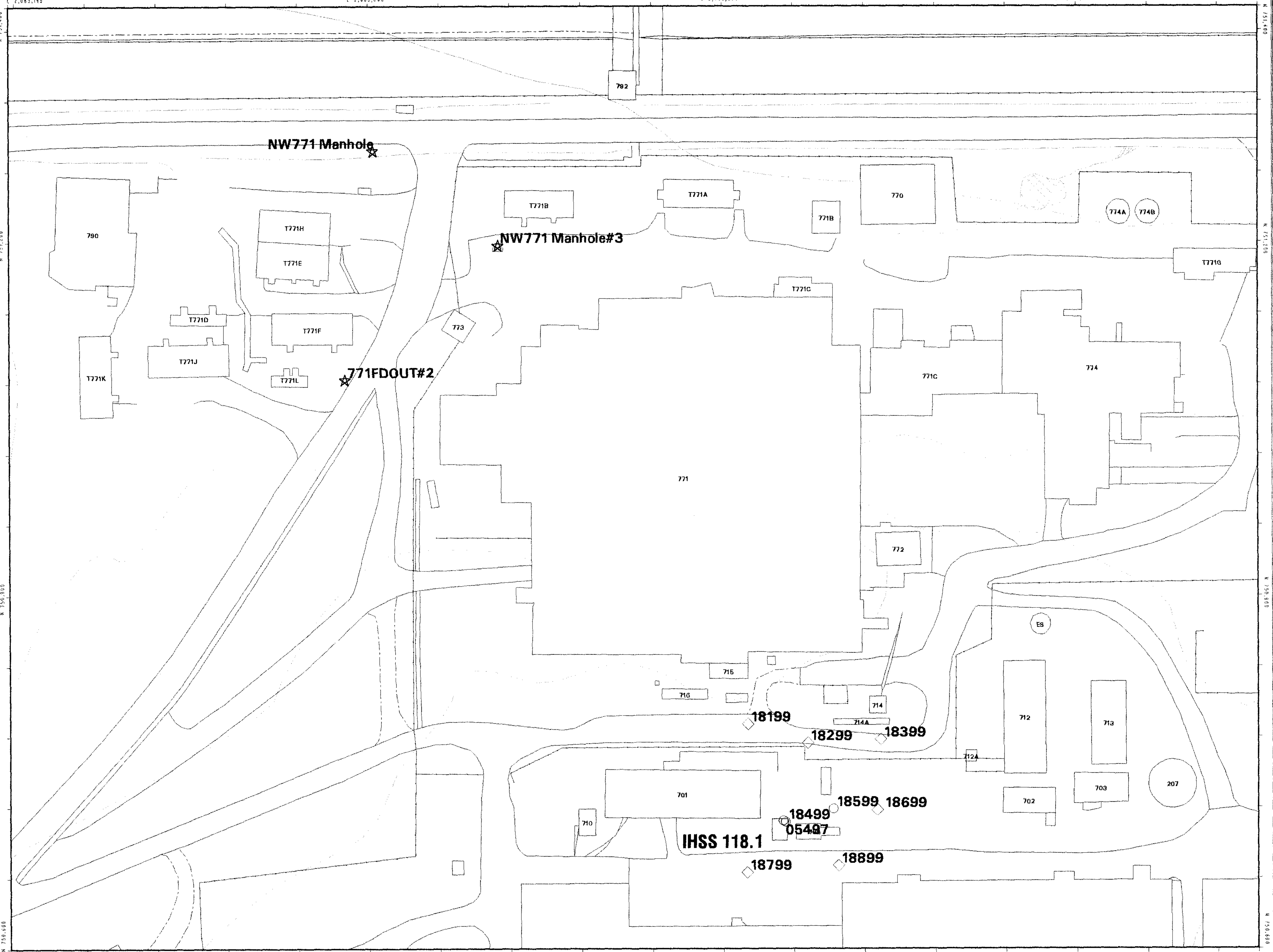

Figure 4-9
Location Map
IHSS 118.1 Wells

IHSS 118.1 Wells

- ○ Alluvial Wells
- △ Bedrock Wells
- ◇ Alluvial/Bedrock Wells
- ☆ Surface Water Monitoring Locations
- Location of IHSS 118.1

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 1030
1 inch represents approximately 86 feet

25 0 50 100ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0365 September 27, 1999

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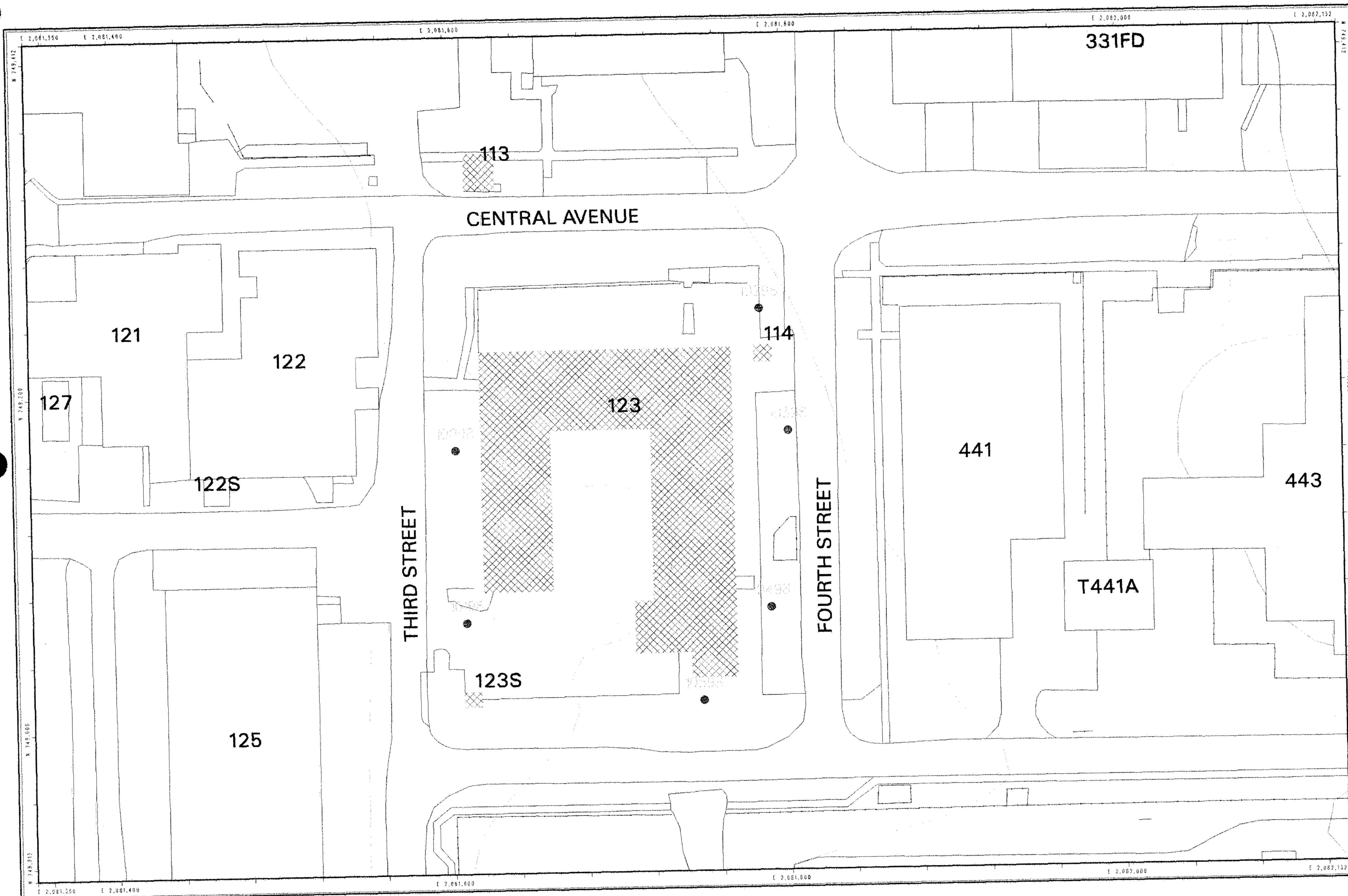
153

Figure 5-1
Building 123 Location Map
with D&D Monitoring Wells



EXPLANATION

IMP Well Type

D&D Monitoring

Standard Map Features

Buildings and other structures

Demolished Buildings

Streams, ditches, or other drainage features

Fences and other barriers

Contour (5-Foot)

Paved roads

Dirt roads

Scale = 1 : 760
1 inch represents approximately 63 feet

25 0 50 100ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: rfca-rpt

September 27, 1999

NT_Svr w:/projects/fy99/rfca-rpt/location_maps/bldg_123-nt.aml

169

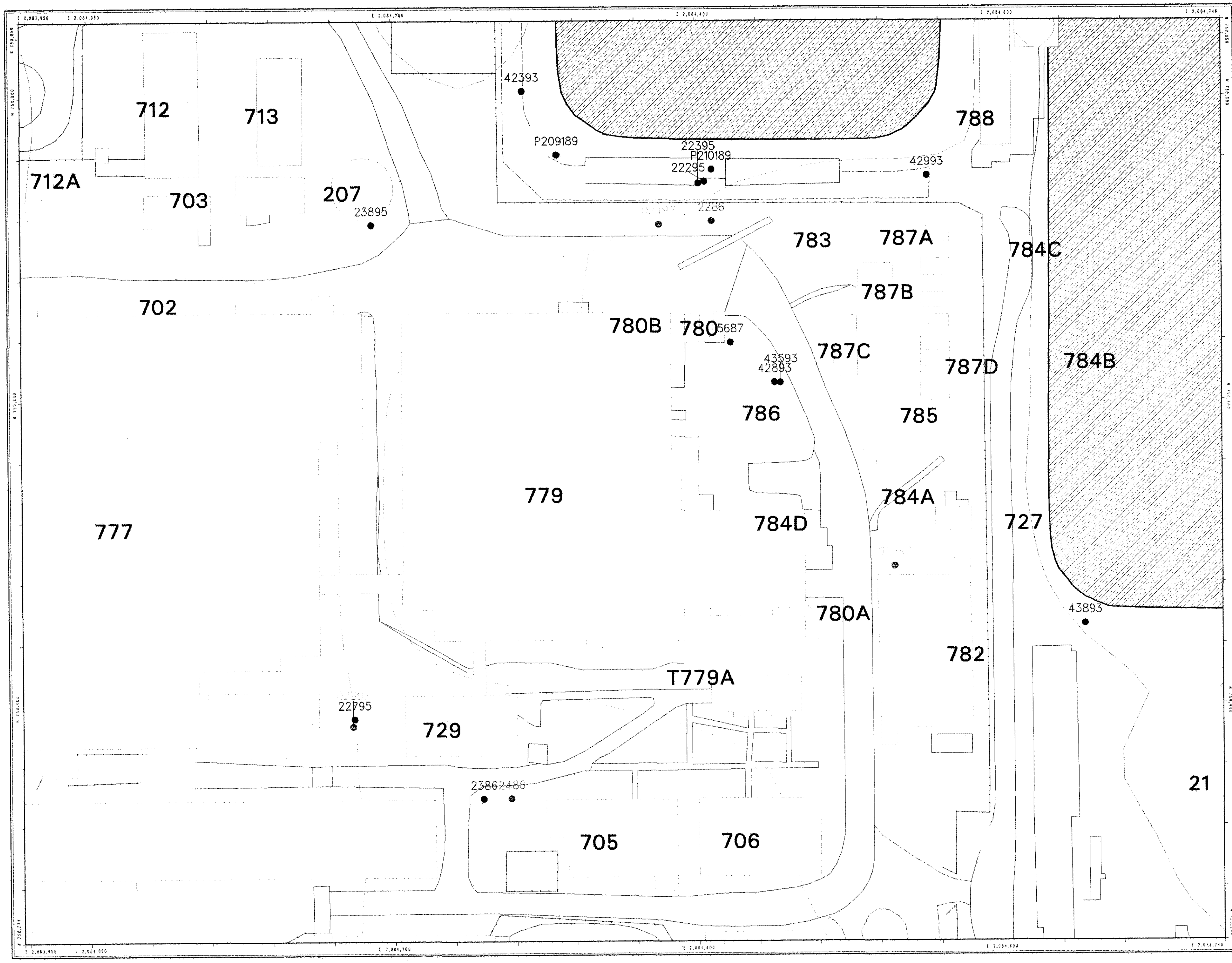

Figure 5-2
Building 779 Location Map with D&D Monitoring Wells

EXPLANATION

IMP Well Type
- Water Quality Flow Monitoring
- Industrial Area Flow Monitoring
- Background Flow Monitoring
- Demolition & Destruction Monitoring
- Non-IMP

Standard Map Features
- Buildings
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Paved roads
- Dirt roads

N

Scale = 1 : 780
1 inch represents 65 feet

20 0 40 80ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: rfca-rpt

September 28, 1999

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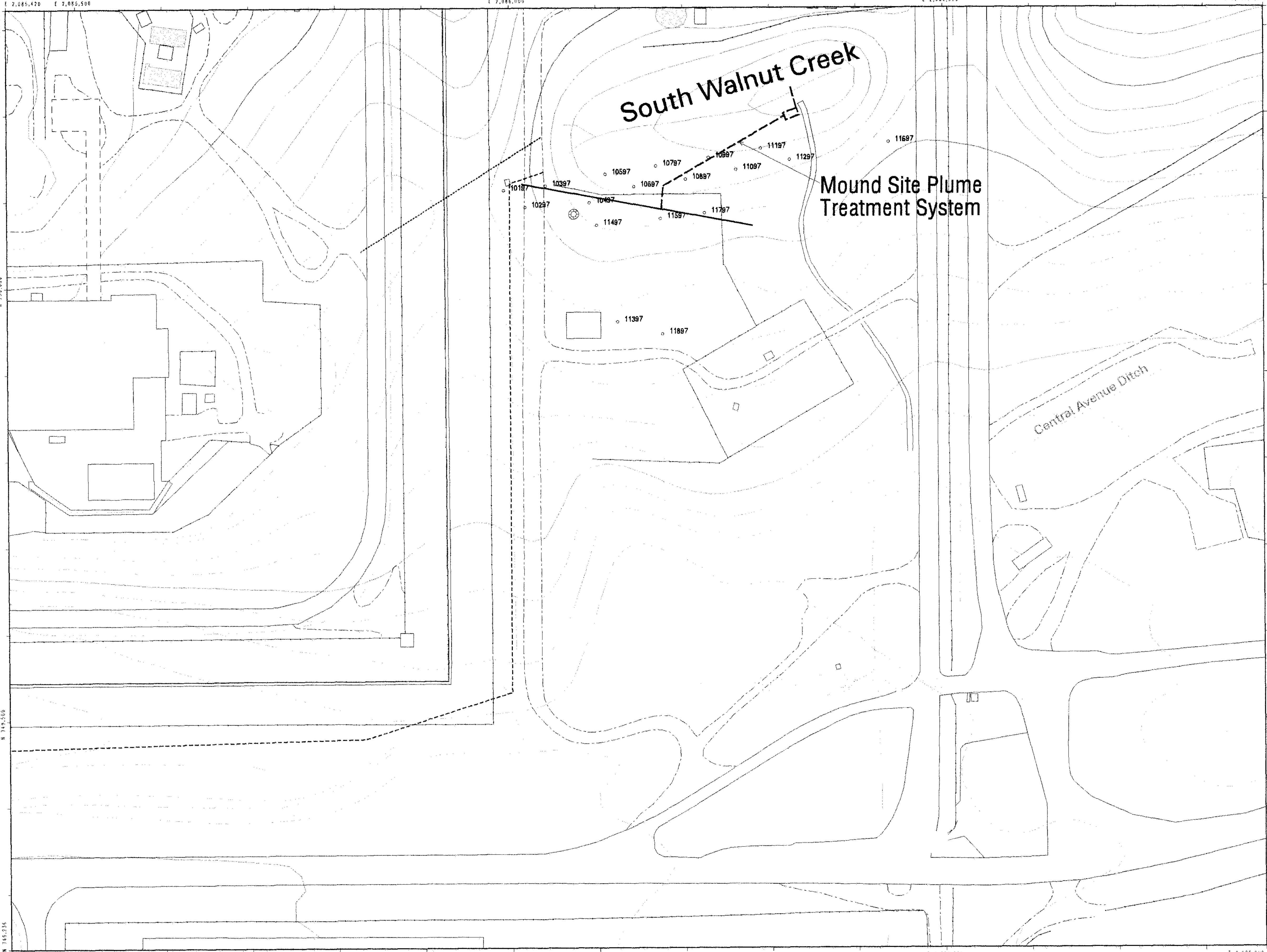
Figure 6-1
Mound Site Plume Area

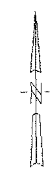


EXPLANATION

- Selected IHSS Boundaries
- Approximate Location of Collection Trench
- Approximate Location of Piping and Treatment System
- Approximate Location of 72" Storm Sewer
- Large Diameter Culvert
- Recent Geoprobe Sampling Locations
- SW059 Holding Tank

Standard Map Features

- Buildings and other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Rocky Flats boundary
- Paved roads
- Dirt roads



Scale = 1 : 1400
1 inch represents approximately 117 feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0000

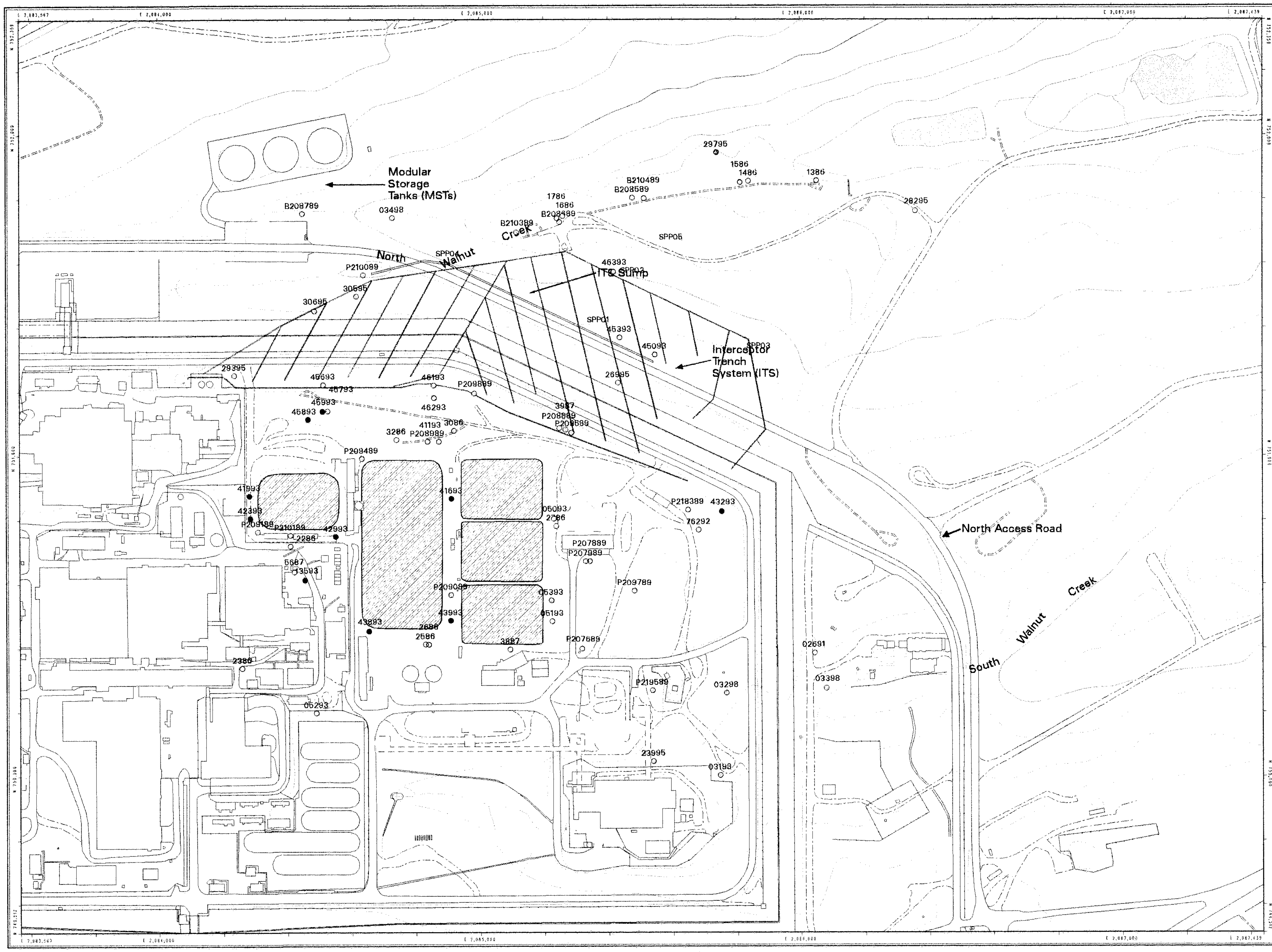
September 27, 1999

NT_Svr w:/projects/fy99/99-0437/moundsite.aml

174

Figure 6-2

Plan View of Reactive Barrier Treatment System Solar Ponds Plume



EXPLANATION

- LHSU Bedrock Monitoring Well
- UHSU Bedrock Monitoring Well
- Bedrock/Alluvium Monitoring Well
- Alluvium Monitoring Well
- Collection Trench

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs. 1/95
Topology (contours) were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

Scale = 1 : 3800
1 inch represents approximately 317 feet

100 0 200 400ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 98-0245

September 28, 1999

NT_Svr w:/projects/fy98/98-0245/samploo-spond/ac_nitrate_con-uhsu.aml

177

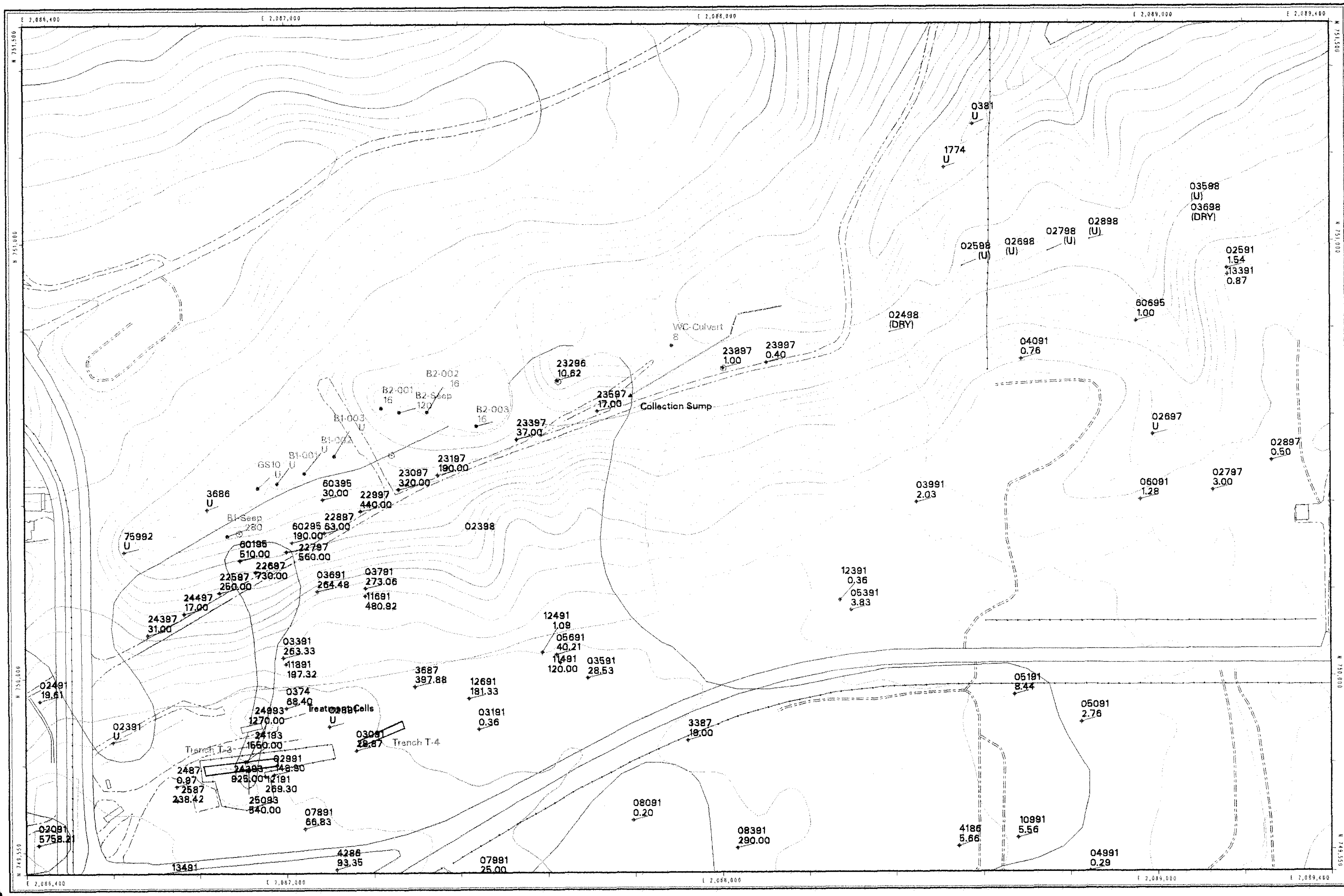

Figure 6-3
East Trenches Plume Study Area

- Tetrachloroethene concentration equal to or greater than 6 ug/L
- Tetrachloroethene concentration equal to or greater than 500 ug/L
- Planned Location of Groundwater Collection System
- Proposed Monitoring Wells
- Sampled Well Location (installed 1988)
- Existing Data Location
- Surface Water Sample Points

Standard Map Features

- Buildings and other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Rocky Flats boundary
- Paved roads
- Dirt roads

Scale = 1 : 2920
1 inch represents approximately 243 feet

100 0 200 400ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 98-0236 September 27, 1999

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180

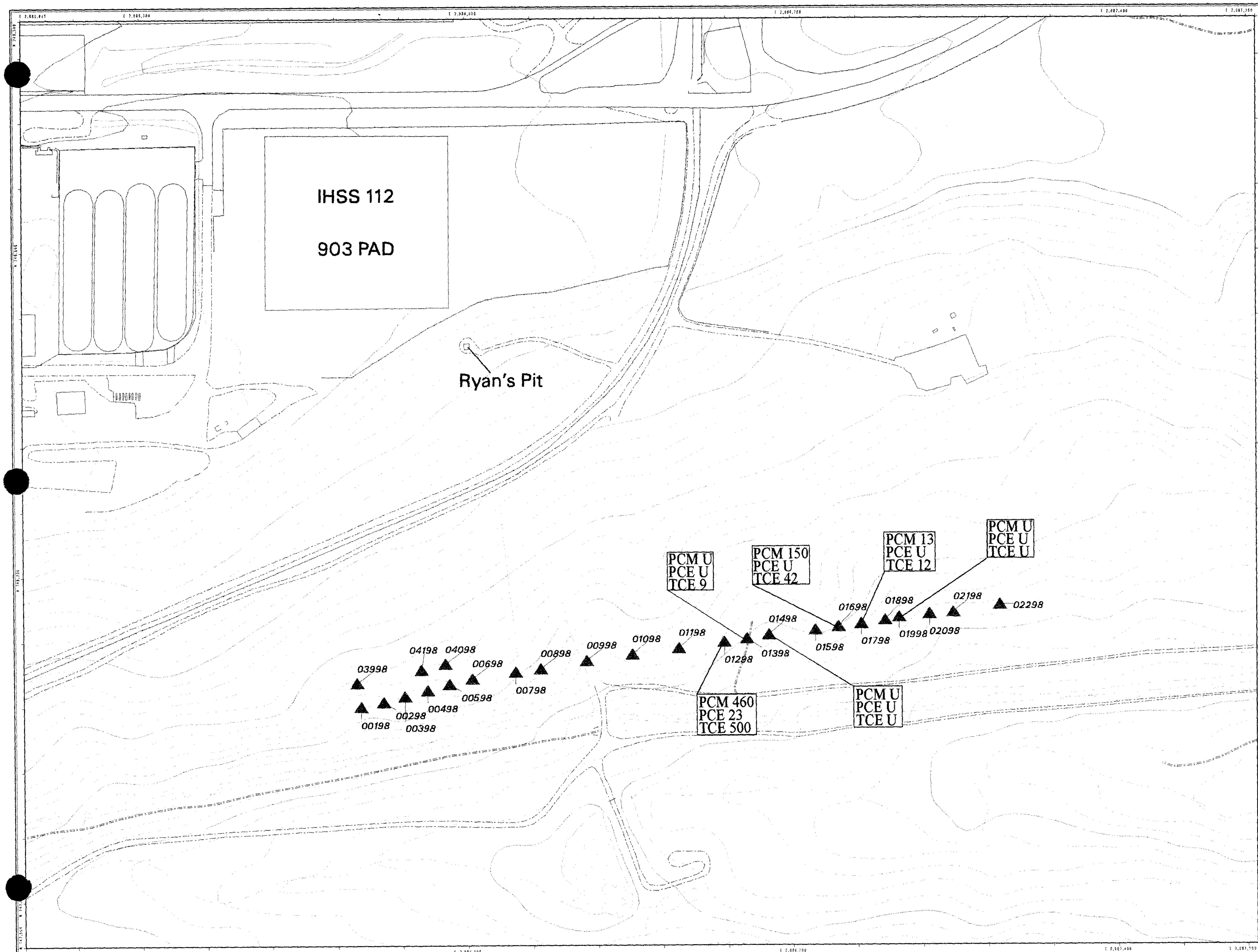

Figure 6-4
903 Pad/Ryan's Pit Area Location Map

EXPLANATION

▲ Temporary wells installed in 1998

Standard Map Features

- Buildings and other structures
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (5-Foot)
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95
Topology (contours) were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

Scale = 1 : 2470
1 inch represents approximately 206 feet

50 0 100 200ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0238

September 27, 1998

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183

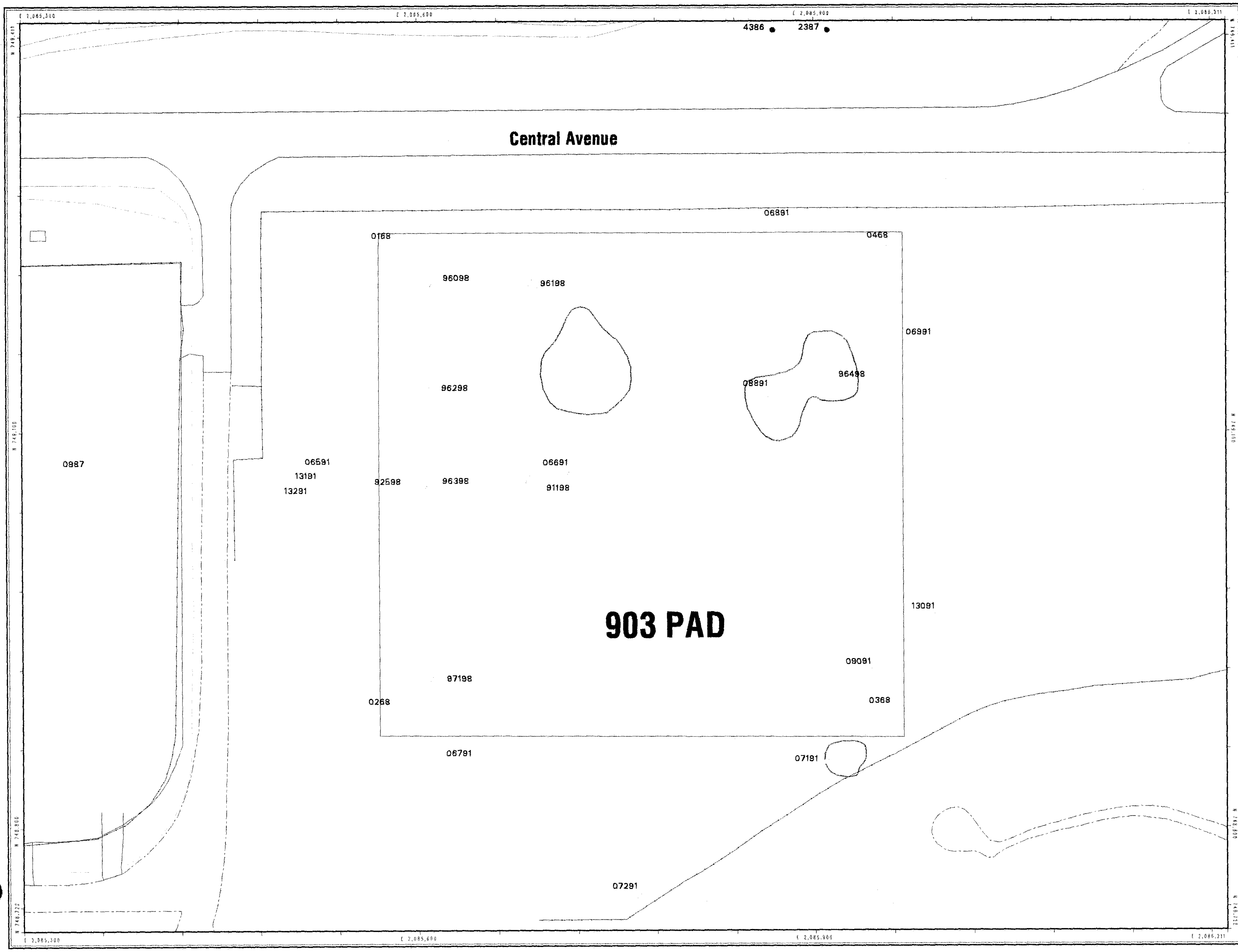

Figure 6-5

VOC Investigation Borehole Location Map 903 Pad

EXPLANATION

VOC Boreholes Completed in 1998

Groundwater Monitoring Well

Soil Gas Concentrations > 100 ppm

Individual Hazardous Substance Site (IHSS 112)

Standard Map Features

Lakes and ponds

Streams, ditches, or other drainage features

Fences and other barriers

Paved roads

Dirt roads

DATA SOURCE: Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 890
1 inch represents approximately 74 feet

25 0 50 100ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: rfca-rpt September 28, 1999

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186

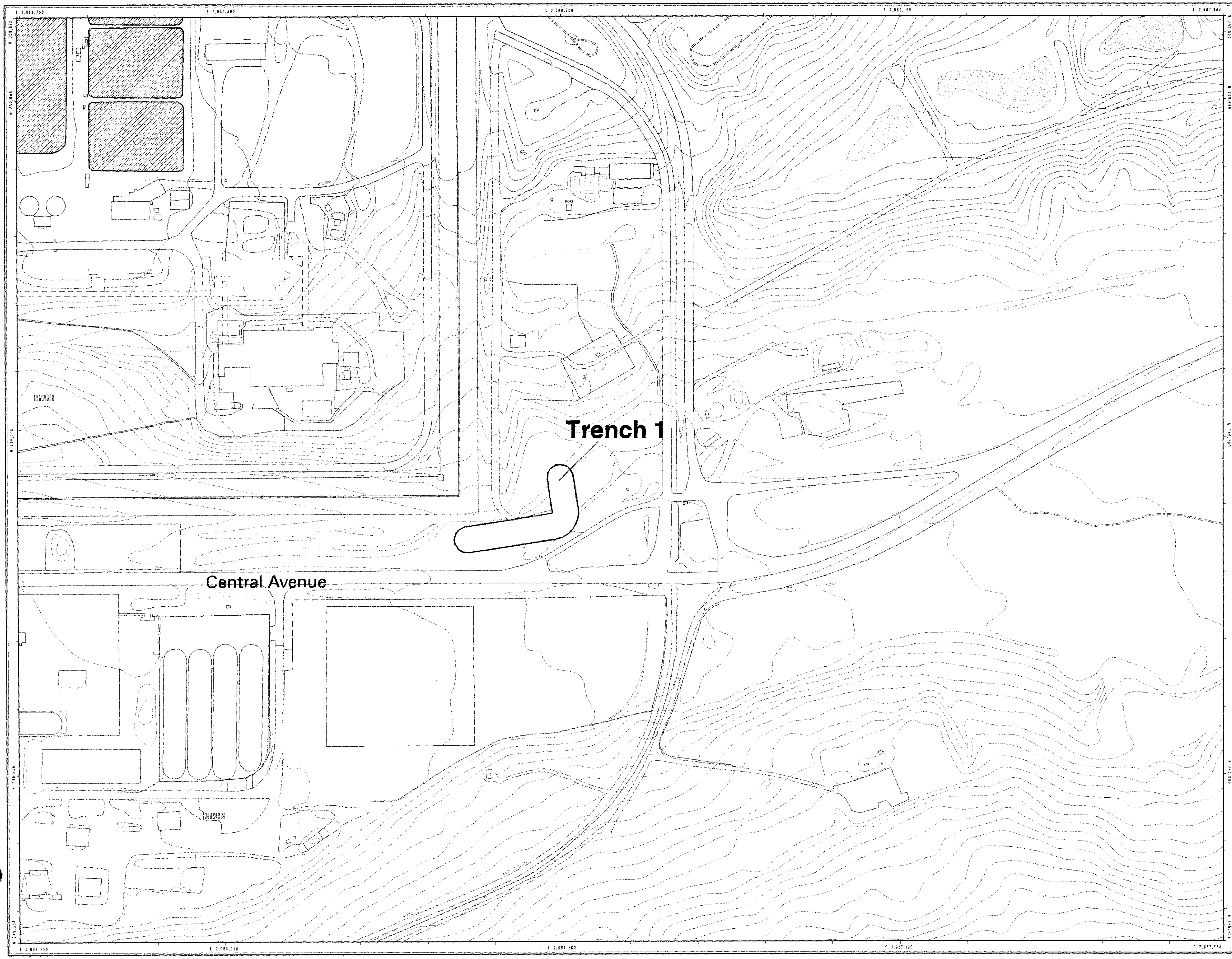

Figure 6-6

Trench 1
Site Location

EXPLANATION

- Contours (5' intervals)
- Trench 1 Tent
- Trench 1

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs. 1/95

Scale = 1 : 2990
1 inch represents approximately 249 feet

50 0 100 200 ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0437

September 28, 1999

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188

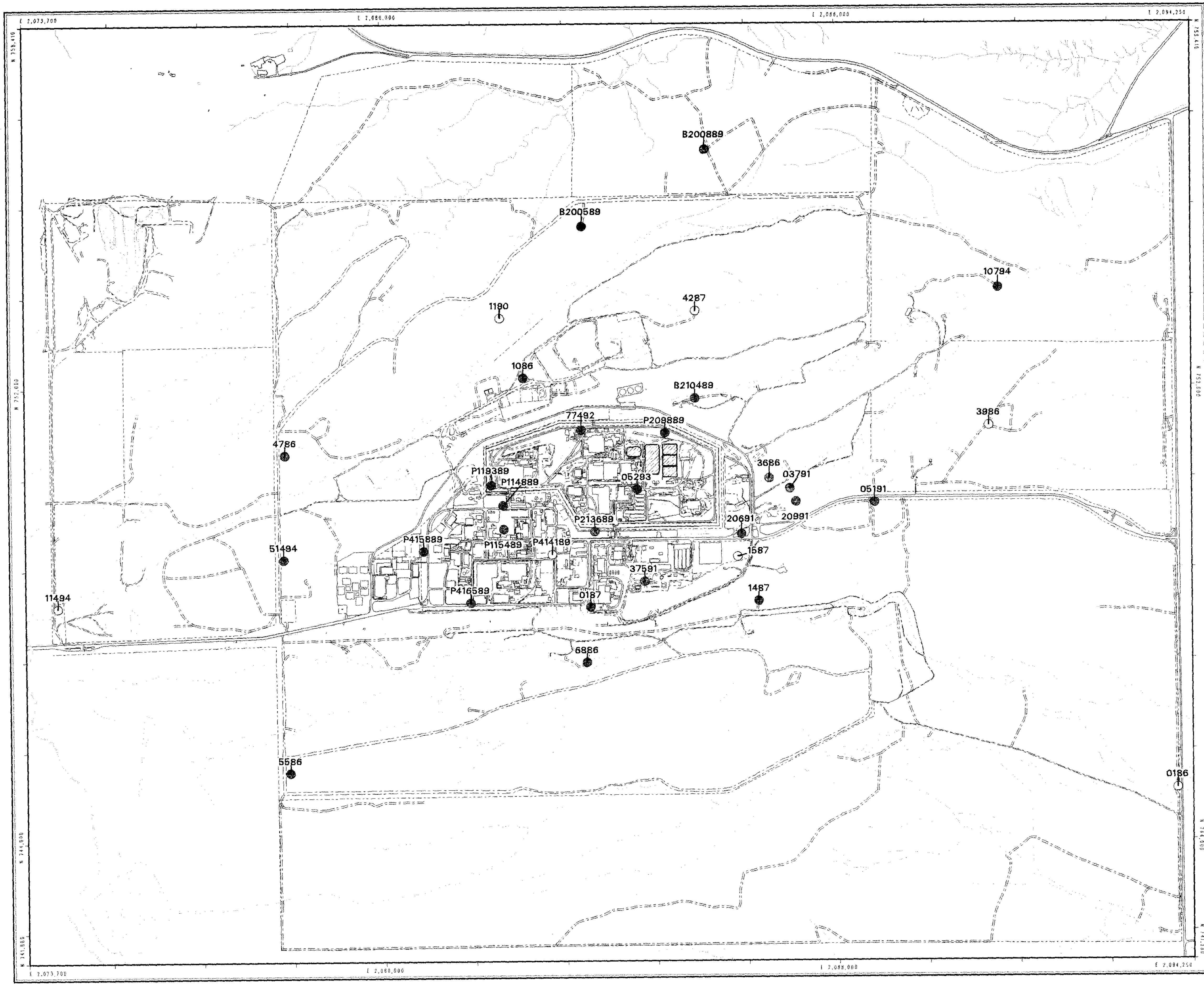

Figure 7-1
Real-Time Groundwater Monitoring Well Locations

EXPLANATION

- ● Groundwater well with real time water level monitoring
- ○ Groundwater well added to real time water level monitoring program during 1999

Standard Map Features

- Buildings and other structures
- Solar Evaporation Ponds (SEP)
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs. 1/95

Scale = 1 : 21330
1 inch represents approximately 1778 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 98-0191

September 28, 1999

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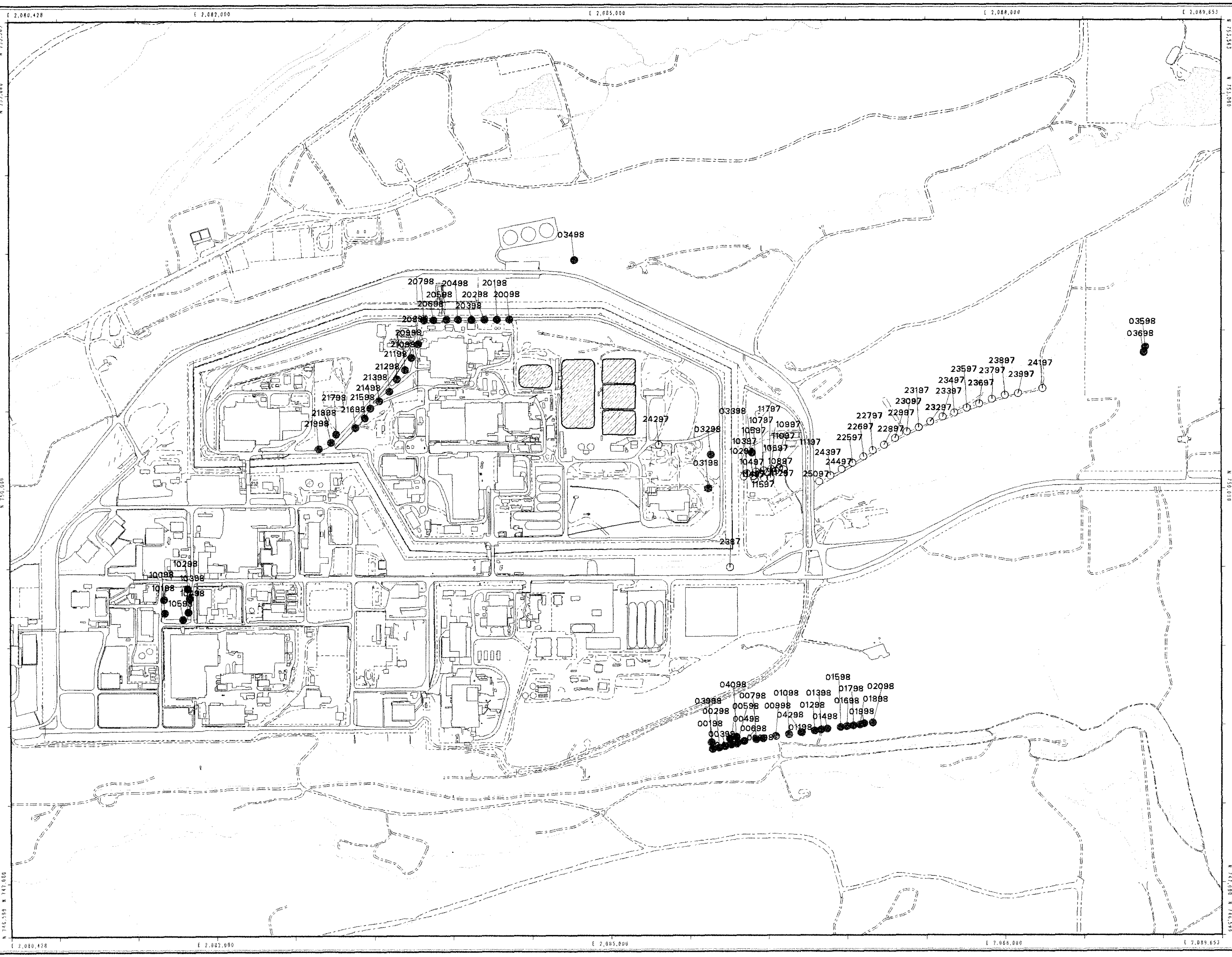

Figure 7-2
CY1998
Well Abandonments and Completions

EXPLANATION

1998 Groundwater Monitoring Well Abandonments

1998 Groundwater Monitoring Well Completions

Standard Map Features

Buildings and other structures

Solar Evaporation Ponds (SEP)

Lakes and ponds

Streams, ditches, or other drainage features

Fences and other barriers

Paved roads

Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

Scale = 1 : 8980
1 inch represents approximately 748 feet

250 0 500 1000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0430

September 28, 1999

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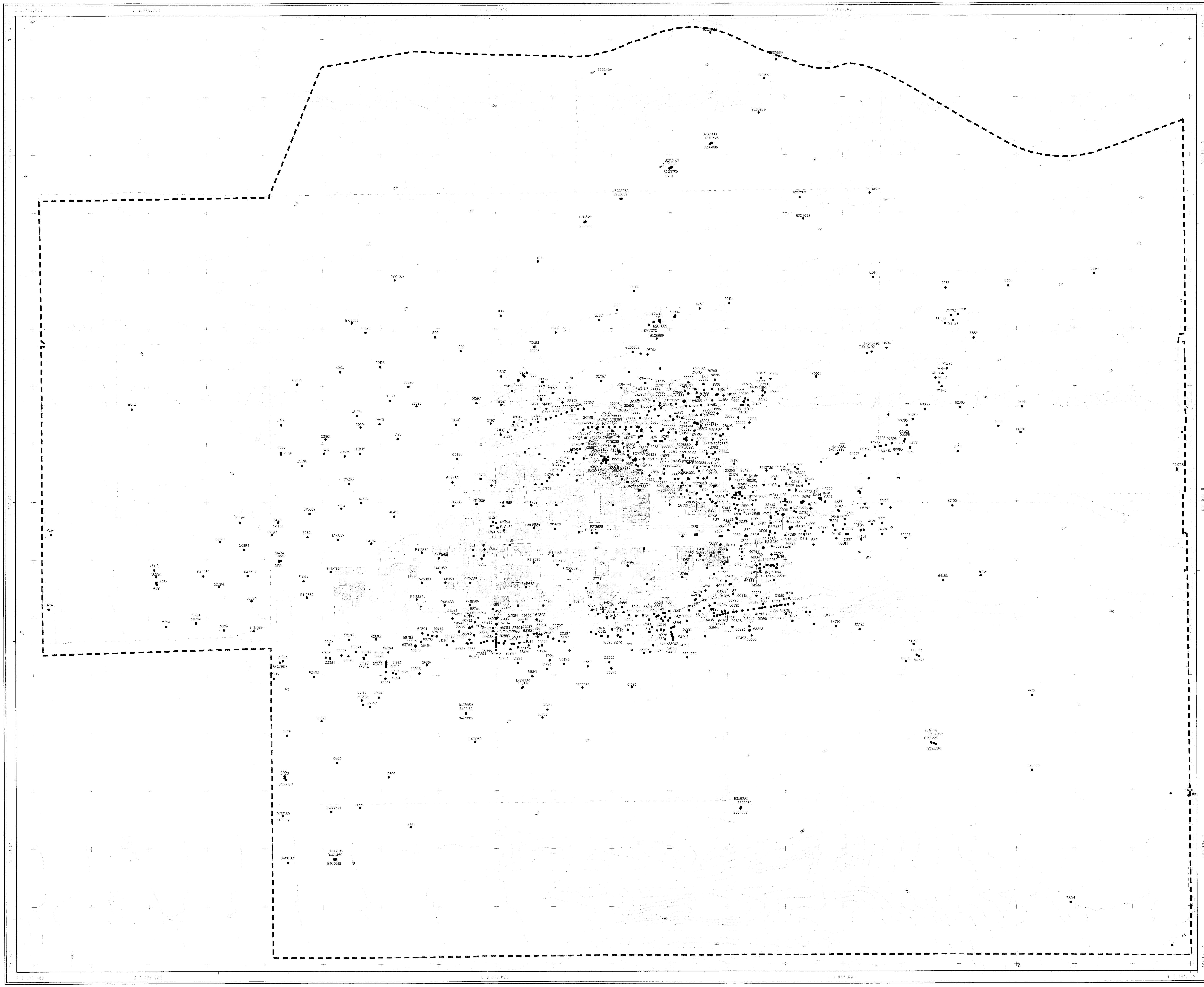

Plate 1
IMP Monitoring
Well Location Map

EXPLANATION

IMP Well Type
- Water Quality Flow Monitoring
- Industrial Area Flow Monitoring
- Background Flow Monitoring
- D&D Monitoring
- Non-IMP

Standard Map Features
- Buildings
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contours (20' Intervals)
- Roads
- Rocky Flats Boundary

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas. Digitized from the orthophotographs. 1/95

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Scale = 1 : 7200
1 inch represents 600 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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rfca

ADMIN RECORD
SW-A-003446

September 23, 1999

Plate 9
Water Level Change Map
1996 - 1998
Fourth Quarter Data

- Groundwater Monitoring Well (with change in water level)
- Contour depicting Positive Change In Water Level
- Contour depicting Negative Change In Water Level
- Contour depicting Zero Change In Water Level

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs. 1/95
Topology (contours) were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

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Scale = 1 : 7760
1 inch represents approximately 647 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0381 ADMIN RECORD SW-A-003446 p. 211 August 13, 1999

Plate 8
Water Level Change Map
1996 - 1998
Second Quarter Data

- Groundwater Monitoring Well (with change in water level)
- Contour depicting Positive Change In Water Level
- Contour depicting Negative Change In Water Level
- Contour depicting Zero Change In Water Level

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

DATA SOURCE:
Buildings, fences, hydrography, roads and other structures from 1994 aerial fly-over data captured by EG&G RSL, Las Vegas.
Digitized from the orthophotographs. 1/95
Topology (contours) were derived from digital elevation model (DEM) data by Morrison Knudson (MK) using ESRI Arc TIN and LATTICE to process the DEM data to create 5-foot contours. The DEM data was captured by the Remote Sensing Lab, Las Vegas, NV, 1994 Aerial Flyover at ~ 10 meter resolution. DEM post-processing performed by MK, Winter 1997.

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Scale = 1 : 7760
1 inch represents approximately 647 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0381 ADMIN RECORD September 01, 1999

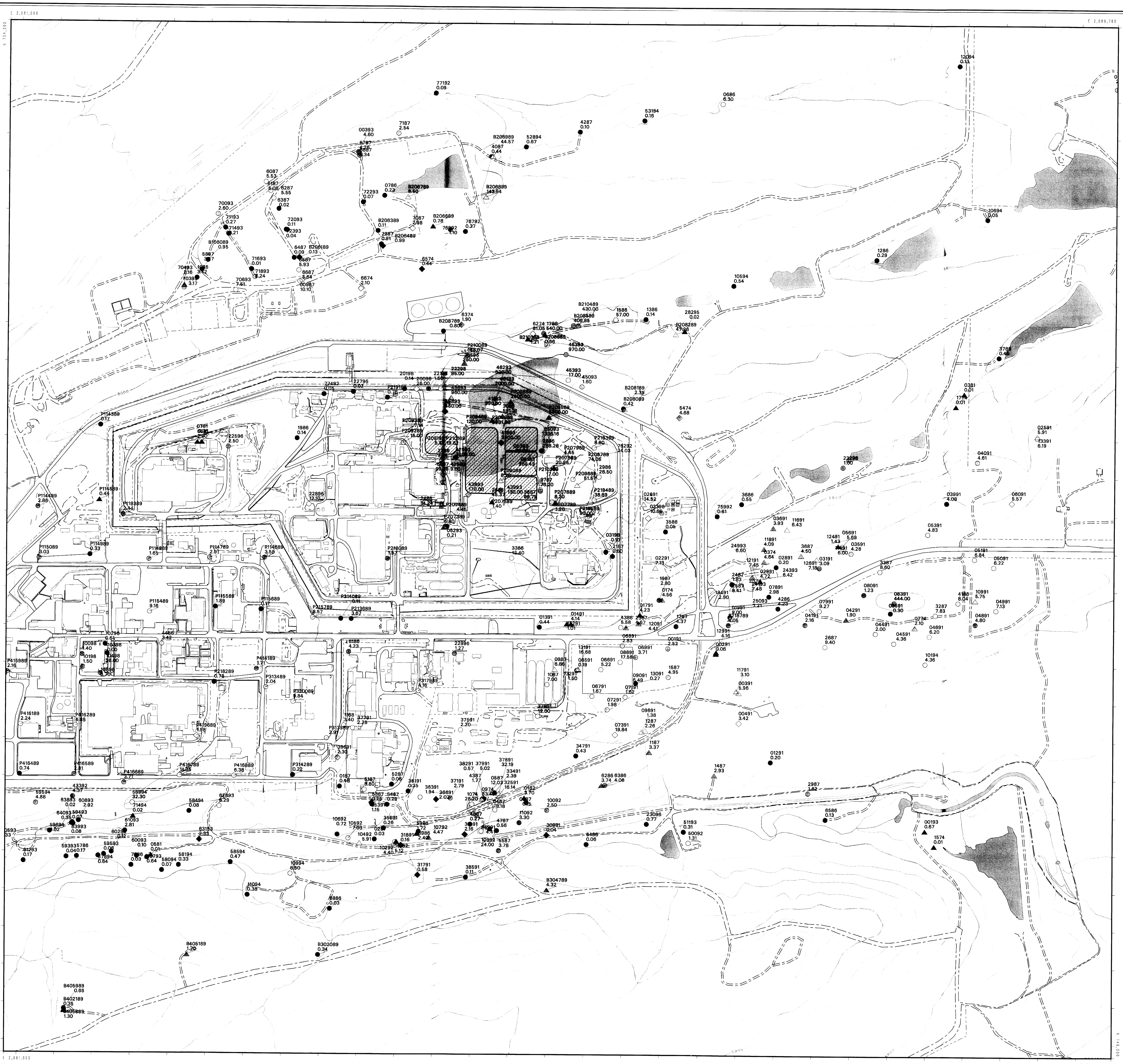

Plate 7
Nitrate Concentration in Groundwater, 1991-1998 (Avg.)

Nitrate concentration equal to or greater than 10 mg/L (as N)

Nitrate concentration equal to or greater than 1000 mg/L (as N)

Nitrate Concentration (mg/L)

- 0 - 1
- 1 - 5
- 5 - 10
- 10 - 100
- 100 - 1000
- > 1000

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

Scale = 1 : 3180
1 inch represents 265 feet

250 0 500 1000ft

State Plane Coordinate Projection
Colorado Central Zone
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SW-A-003440

September 01, 1999

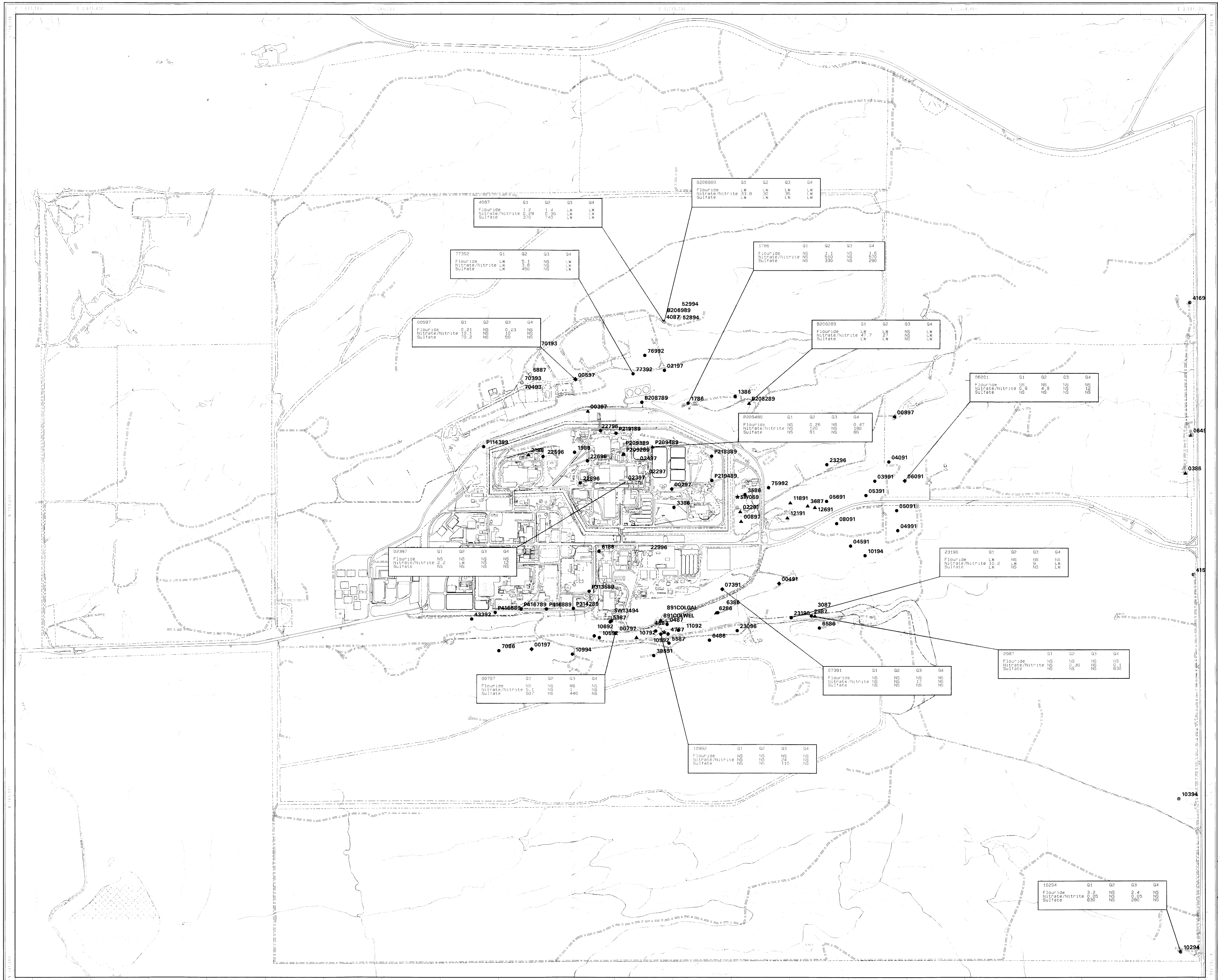

Plate 6
Water Quality Parameters in Groundwater RFCA Wells, 1998

Well Classifications

- Plume Definition
- Plume Extent
- Performance Monitoring
- Drainage
- Boundary
- RCRA
- D&D

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells
- Surface Water Monitoring Locations

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

one value above Tier 2 Action Levels

NS = Not Sampled
LW = Lack of Water
BDL = Below Detectable Limit

All results in milligrams per liter (mg/L)

Scale = 1 : 7090
1 inch represents approximately 591 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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SW-A-003446

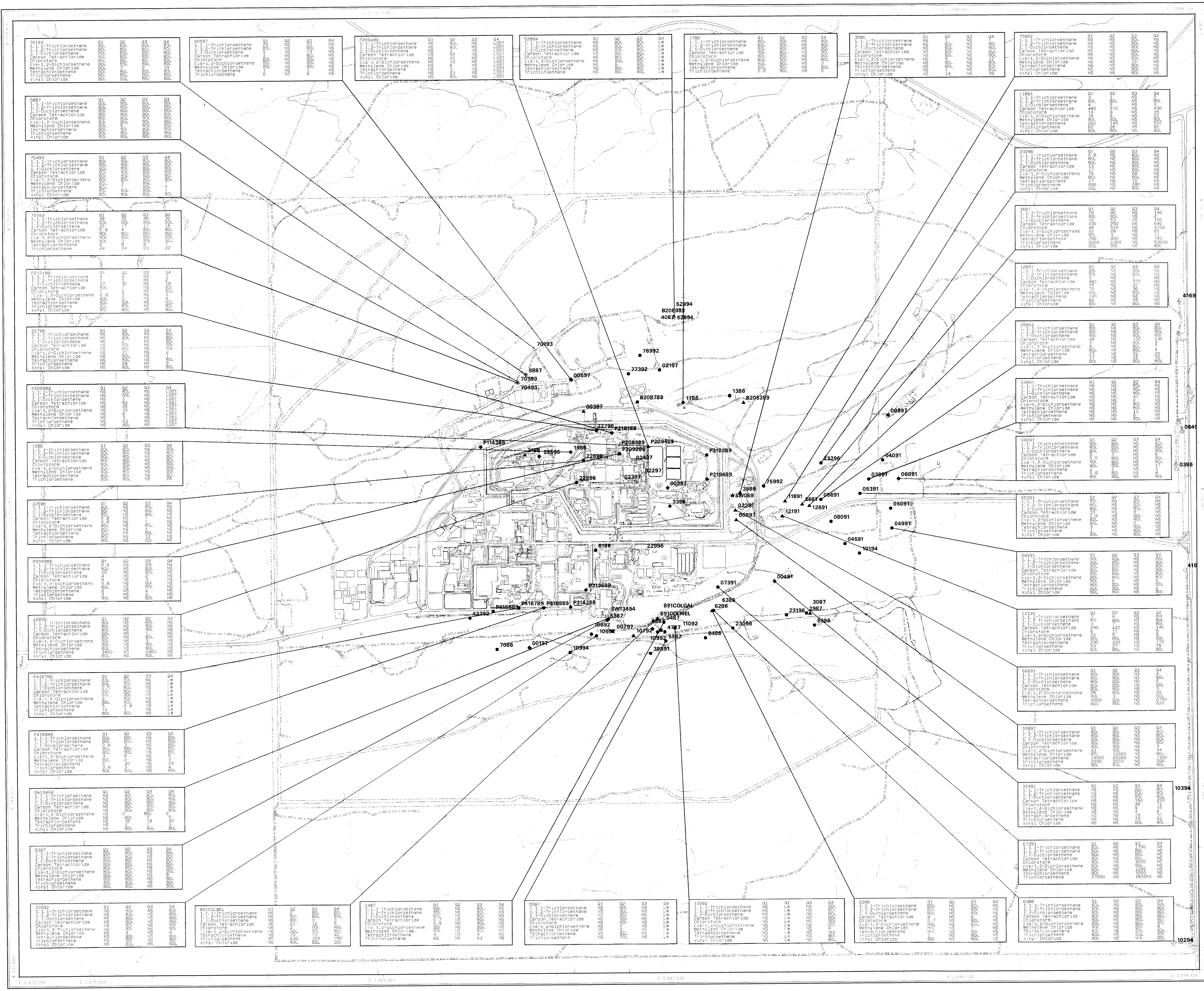

Plate 5
VOCs in Groundwater
RFCA Wells, 1998

Well Classifications

- Plume Definition
- Plume Extent
- Performance Monitoring
- Drainage
- Boundary
- RCRA
- D&D

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells
- Surface Water Monitoring Locations

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

NS = Not Sampled
LW = Lack of Water
BDL = Below Detectable Limit

Scale = 1 : 7090
1 inch represents approximately 591 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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MAP ID: 99-0352 ADMIN RECORD SW-A-003446 pg 37 September 01, 1999

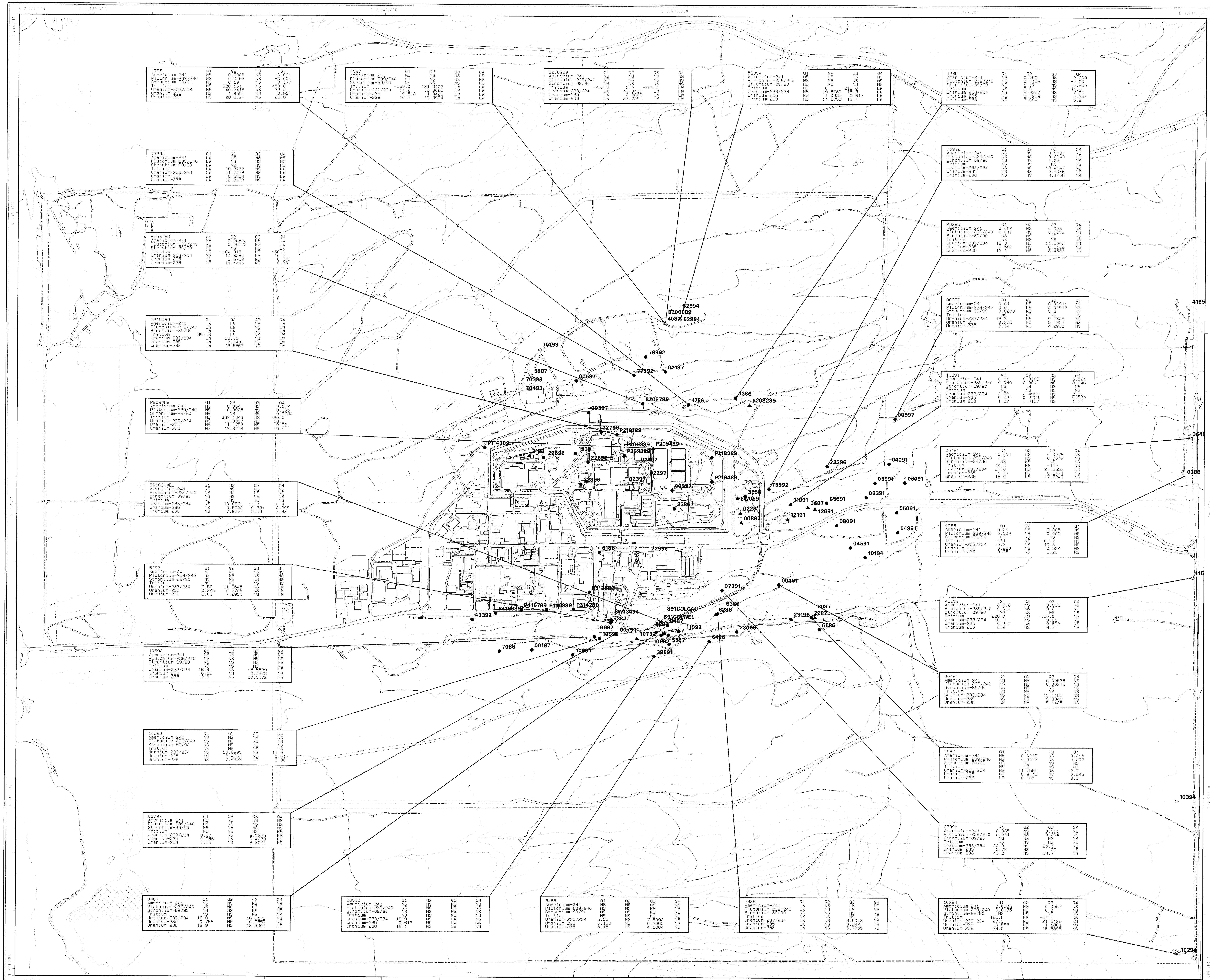

Plate 4
Radionuclides in Groundwater RFCA Wells, 1998

Well Classifications

- Plume Definition
- Plume Extent
- Performance Monitoring
- Drainage
- Boundary
- RCRA
- D&D

- Alluvial Wells
- Bedrock Wells
- Alluvial/Bedrock Wells
- Surface Water Monitoring Locations

Standard Map Features

- Buildings and other structures
- Solar evaporation ponds
- Lakes and ponds
- Streams, ditches, or other drainage features
- Fences and other barriers
- Contour (20-Foot)
- Paved roads
- Dirt roads

one Uranium value above 8.0 pCi/L

NS = Not Sampled
NA = Not Analyzed
LW = Lack of Water

All results in picoCuries per liter (pCi/L)

Scale = 1 : 7090
1 inch represents approximately 591 feet

500 0 1000 2000ft

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

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